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# GASTROPODS OF THE MIDDLE DEVONIAN ANDERDON LIMESTONE

By

ROBERT M. LINSLEY

1968

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Ithaca, New York 14850, U.S.A.

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September 5, 1968

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# GASTROPODS OF THE MIDDLE DEVONIAN ANDERDON LIMESTONE

ROBERT M. LINSLEY

## ABSTRACT

This paper is concerned with the stratigraphic occurrence and study of the large and interesting gastropod assemblage found in the Middle Devonian Anderdon Limestone. This limestone is the uppermost unit of the largely calcareous Detroit River Group and its area of outcrop is apparently limited to southeastern Michigan, southwestern Ontario, and northwestern Ohio. The overall stratigraphic position of the Anderdon Limestone is briefly discussed, though because of the limited value of gastropods as index fossils, this fauna provides little additional information regarding its relative age. The comparative ages of the three gastropod beds of the Anderdon are discussed, and it is here suggested that they are not synchronous.

The paleoecological setting is also discussed briefly. In general it was found that there are two primary ecologic environments represented within the Anderdon. One of these environments consists primarily of a biostromal aggregation of corals and the gastropods apparently lived in this protected environment. The gastropods inhabiting this biostrome are predominantly small and this environment is represented in all three quarries that were visited by the author. The second environment is known only from the Brunner, Mond Canada, Limited quarry of southeastern Ontario and consists of a fine calcilutite inhabited by an assemblage of gastropods whose average size greatly exceeds the average size of those found in the reef environment. This second environment has been interpreted as being a protected back-reef or inter-reef environment.

Following the section on paleoecology there is a brief discussion of preservation and techniques. Almost all of the gastropods occur as external molds in various states of preservation. To study the gastropods it was necessary to make casts of each mold, and this was accomplished by using a latex molding compound. Most photographs used in the plates are of the latex casts.

The bulk of this paper is devoted to systematic descriptions of new genera and species and to a brief discussion of other new forms which are not well enough preserved to warrant description. Over 50 different gastropods have been discovered in the Anderdon limestone, only two of which have previously been described.

The gastropods constitute a varied aggregation belonging to 27 genera representing the superfamilies Bellerophontacea, Macluritacea, Euomphalacea, Pleurotomariacea, Platyceratacea, Microdomatacea, Anomphalacea, Pseudophoracea, Neritacea, Murchisoniacea, Loxonematacea, and Pyramidellacea.

Of the 50 species discussed, 33 are considered new. Included in these 33 species are six genera which are considered new. They include *Ehlersina*, *Zalozone*, *Tylozone*, and *Nodonema* (of the superfamily Pleurotomariacea), *Copidocatomus* (of the superfamily Microdomatacea), and *Crenulazona* (of the superfamily Murchisoniacea).

## GENERAL STATEMENT

This paper deals primarily with a discussion of the gastropod fauna of the Anderdon Limestone, the youngest formation of the Middle Devonian Detroit River Group exposed in southeastern Michigan, northwestern Ohio, and southeastern Ontario. Gastropods comprise a remarkably large and distinctve element of the fauna of the Anderdon Limestone. They seem to be restricted to this limestone and hence are extremely useful in differentiating the An-

derdon Limestone from underlying formations of the Detroit River Group and the overlying Middle Devonian Dundee Limestone.

Over 50 different species of gastropods have been found in the Anderdon Limestone, but unfortunately many of these are undescribable at the present time because of a lack of well-preserved specimens. Nevertheless enough well-preserved specimens were found to describe 33 new species and six new genera *(Ehlersina, Tylozone, Nodonema, Zalozone, Crenulozona* and *Copidocatomus)*. In all, 50 different species of gastropods belonging to 27 different genera are discussed.

In addition to the formal descriptions of the species of gastropods of the Anderdon Limestone, a brief account of the stratigraphy of the Anderdon Formation is included, as are observations on the inferred ecology of the Anderdon sea.

This study was initiated at the Museum of Paleontology of the University of Michigan when the author was a research assistant there. During the last year of work by the author on this study the research was sponsored by the National Science Foundation, and many of the expenses incurred in the final preparation of this manuscript were defrayed by grants from the Littauer Foundation and the Research Council of Colgate University.

Dr. G. M. Ehlers of the University of Michigan suggested this project as a subject for a doctoral dissertation. Throughout the entire period of study he proved to be a prime source of inspiration, and the author spent many stimulating hours discussing the various aspects of this problem with him. Dr. Ehlers also made available not only the facilities of the University of Michigan Museum of Paleontology but also provided the basic collection of Anderdon gastropods that he had collected with the assistance of Dr. E. C. Stumm and Dr. R. V. Kesling, both of whom are also associated with the University of Michigan. The author is further indebted to Dr. Ehlers for his company and guidance on numerous field trips to the outcrop areas of the Anderdon Limestone.

The writer received many ideas concerning the possible extent and nature of the Anderdon sea from interesting discussions with Dr. Stumm. Dr. Kesling also aided the progress of this study with numerous helpful observations on methodology and techniques. Because of the small size of many of the gastropods, Dr. Kesling's

familiarity with micropaleontological techniques was particularly helpful in aiding the writer in preparing and photographing the specimens. Mr. Herbert Wienert, photographer for the University of Michigan Museum of Paleontology, helped the author with some of the photography.

The author greatly enjoyed the friendly and stimulating correspondence with Dr. Ellis L. Yochelson, Dr. Roger L. Batten, and the late Dr. J. Brooks Knight. All three gentlemen gave unhesitatingly of their time and greatly aided the determination of the systematic position of many elements of this fauna, as well as fascinating suggestions regarding many other problems encountered in the course of this study.

Dr. Henry Van der Schalie of the Museum of Zoology of the University of Michigan aided the writer with many informative hours of conversation regarding modern mollusks and thus provided some possible analogies to the problems encountered in the Paleozoic snails.

Finally and most gratefully the author acknowledges the many ungrudging hours his wife, JoAnn Hoehler Linsley, his sister, Anne E. Linsley, and Mrs. Haskell R. Fenner spent in preparing this manuscript. They were a never failing source of encouragement and their efforts are sincerely appreciated.

## STRATIGRAPHY OF THE ANDERON LIMESTONE

To fully understand the stratigraphic distribution of the gastropods described in this paper, it is necessary to briefly describe the stratigraphy of the Anderdon Limestone.

The term Anderdon Limestone was first used by W. H. Sherzer and A. W. Grabau (1908, p. 408) for the "middle member" of the "Upper Monroe" strata, which, according to those authors, occupy a position between the underlying Sylvania Sandstone and the overlying Dundee Limestone. No type locality or detailed description of the Anderdon Limestone was given by those investigators *(op. cit.)*.

In 1909 Sherzer and Grabau (1909, p. 542) indicated that the term Anderdon Limestone was taken from the "Anderdon quarry, in Anderdon township, Essex County, Ontario, about 2 miles east

of Amherstburg and 15 miles south of Detroit." They *(op. cit.)* described the lithology of the Anderdon Limestone and the disconformity between this limestone and the overlying Dundee Limestone of the quarry, which is now owned by the Brunner, Mond Canada Ltd.

In the same reference, Sherzer and Grabau (1909, pp. 541, 542, text-figure 1) indicated that the Anderdon Limestone overlies the Flat Rock Dolomite, which rests on the Sylvania Sandstone, and is respectively overlain by the Amherstburg and Lucas Dolomites. They also described *(op. cit.,* pp. 541, 542) the occurrence of the Anderdon Limestone (not a correlate of type Anderdon Limestone) of the Detroit salt shaft, presented *(op. cit.,* p. 547) a combined list of fossils from the "Anderdon bed" of the shaft and from the type Anderdon Limestone in Anderdon Township, and discussed *(op. cit.,* pp. 543, 544, 551-553) the correlation and faunal differences of the Anderdon and other formations of the Upper Monroe.

A. C. Lane, Charles S. Prosser, W. H. Sherzer, and A. W. Grabau (1909, pp. 553-556) presented a classification of the Monroe Formation of Michigan, Ohio, and western New York. In this classification the lower part of this "formation" was designated the "Lower Monroe or Bass Island series," composed of four stratigraphic units, the middle part the "Middle Monroe" having a single unit, the Sylvania Sandstone, and the upper part the "Upper Monroe," containing four units. In ascending order the four divisions of the Detroit River Series were designated the Flat Rock Dolomite, Anderdon Limestone, Amherstburg Dolomite, and Lucas Dolomite.

Lane, Prosser, Sherzer, and Grabau (1909, p. 555) stated that the name Anderdon Limestone was ". . . suggested by the Reverend Thomas Nattress . . ." and "was adopted by Sherzer and Grabau for the coral reef limestone exposed in the Anderdon quarry, Essex county, Ontario, two miles from Amherstburg, Ontario, and in the salt shaft at Oakwood [part of Greater Detroit], Michigan." They (1909, p. 553) also stated that the highest Silurian strata in America are represented by the Monroe Formation, of which the Anderdon Limestone is a part.

The Anderdon Limestone was described in considerable detail and assigned to the Silurian System by W. H. Sherzer and A. W.

Grabau (1910, pp. 42-47). A. W. Grabau (1910, pp. 87-213) described several gastropods and other invertebrate fossils from the "Anderdon limestone"; some species that he stated as occurring in his Lucas Dolomite of the Detroit salt shaft are now known to belong to the Anderdon Limestone; others, recorded as found in the "Anderdon limestone" of the salt shaft, came from strata that are now known to be of lower Lucas or upper Amherstburg age. Species, described as having been found in the Anderdon Limestone of the Anderdon quarry, belong to this limestone.

C. R. Stauffer (1916, pp. 72-77) in a paper on the relative age of the Detroit River Series and M. Y. Williams (1919, pp. 18-21) in a publication on the Silurian geology and faunas of Ontario Peninsula and Manitoulin and adjacent islands reached the conclusion that the Silurian Series are of Devonian rather than of upper Silurian age. In making this change in classification, Williams (1919, p. 22) stated that "terms upper Monroe and lower Monroe are obviously no longer appropriate, since the so-called Monroe is now seen to belong to different geological systems, Grabau's alternate names 'Detroit River' and 'Bass Island' [original designation is Bass Islands] will hence be used."

J. E. Carman (1927, pp. 481-506) concluded that the Sylvania Sandstone and the overlying Detroit River strata are of Devonian age, the Silurian-Devonian contact in Ohio being at the base of the Sylvania Sandstone. Subsequently Carman (1936, pp. 253-266) described in detail the Sylvania Sandstone of Ohio, noting the unconformity at its base and the gradation of the water-laid phase of the Sylvania into the overlying Detroit River Dolomite.

G. M. Ehlers (1945, pp. 110, 111) regarded the Detroit River strata as a group and stated (*op. cit.*, p. 118) that the Sylvania Sandstone ". . . on further study may prove to be the lowest formation of the Detroit River Group in southeastern Michigan." He (*op. cit.*, pp. 116-120) further showed that the Detroit River strata occupied a position between the underlying Bois Blanc Formation, which is a western extension of the Onondaga Limestone (now designated Bois Blanc Limestone by Canadian geologists) of southwestern Ontario, Canada, and the overlying Dundee Limestone.

In 1950 G. M. Ehlers (1950, pp. 1455, 1456) presented a revised classification of the Detroit River Group in which the oldest forma-

tion, the Sylvania Sandstone, is successively overlain by the Amherstburg Dolomite, the Lucas Dolomite, and the Anderdon Limestone. The Flat Rock Dolomite was regarded by Ehlers *(op. cit.)* as a part of the Amherstburg Dolomite and the term Flat Rock Dolomite omitted in his revised classification.

In 1951, G. M. Ehlers, E. C. Stumm, and R. V. Kesling (pp. 3-17, 23) described the Detroit River Group in considerable detail and classified *(op. cit.*, Chart 1, p. 10) the Anderdon Limestone as the youngest formation of this group.

The type section of the Anderdon limestone is exposed in the Brunner, Mond Canada Ltd. quarry ("Anderdon quarry" of many auhors) in Anderdon township about 1¼ miles northeast of Amherstburg, Ontario (See map, Text-figure 1).

The rocks of this quarry were described by Ehlers, Stumm, and Kesling (1951, pp. 11-13) except for emendations by the author, as follows:

DUNDEE LIMESTONE

Exposed in wall of quarry

| Unit | | Ft. | In. |
|---|---|---|---|
| 1. | Limestone. Total thickness | 48 | 5 |

DISCONFORMITY
ANDERDON LIMESTONE

Exposed in wall and floor of quarry

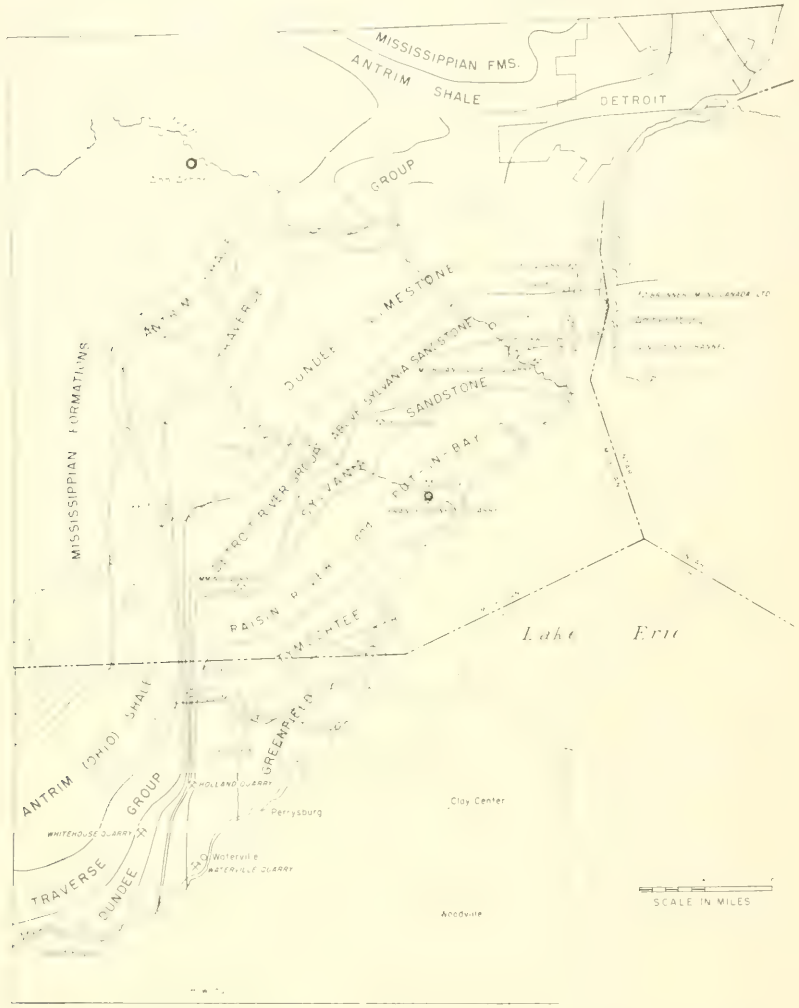
| | | | |
|---|---|---|---|
| 16. | Limestone, light gray to light bluish-gray, finely crystalline, containing *Amphipora nattressi* (Grabau), an athyrid, a costate *Atrypa, Pentamerella* sp., *Leiorhynchus?* sp., several genera and species of cephalopods, and many large, loosely coiled, low-spired gastropods. Molds of gastropods *(Euryzone?* sp. A and B) and cephalopods filled or partly filled with buff, arenaceous and dolomitic-limestone of overlying Dundee Formation. Quartz sand of basal Dundee present in weathered fissures of Anderdon Limestone to a depth of 4 feet below the top of unit 16 (unit 7 of Stauffer, 1915, p. 203). | | 6 |
| 15. | Limestone, light buff-gray, crystalline, containing few stromatoporoids, few poorly preserved tetracorals and brachiopods, many newly described species of relatively large gastropods, including the genera *Zalozone,* n. gen., *Naticopsis, Crenulazona,* n. gen., *Ehlersina,* n. gen., and *Tylozone,* n. gen. Also present are the ostracods *Barychilina* sp., *Kloedenia* sp. and species of the ostracod families Cypridae and Leperditidae. (unit 6 of Stauffer, 1915, p. 203). | 2 | 0 |

| | | | |
|---|---|---|---|
| 14. | Limestone, gray, crystalline, with many specimens of the stromatoporoids, *Amphipora nattressi* (Grabau), *Stictostroma anderdonense* Galloway and Ehlers, *Syringostroma aurora* Parks, and *S. aurorella* Fritz and Waines, many corals including the genera *Cystiphyllodes, Disphyllum, Emmonsia, Favosites,* and *Heterophrentis,* a costate *Atrypa,* an athyrid, *Conocardium sibleyense* LaRocque, undescribed species of the ostracod genera *Aparchites, Isochilina, Kloedenia?,* and *Punctoprimitia.* Small low bioherms composed largely of a digitate *Favosites* in a brown to brownish-black dolomite having considerable asphaltic material present locally in quarry. Also present locally are small biostroms with small gastropods including *Straparollus (Serpulospira) diversiformis* Linsley, n. sp. and *Tropidodiscus cultricarinatus* Linsley, n. sp. (unit 5 of Stauffer, 1915, p. 203). | 4 | 8 |
| 13. | Limestone (calcilutite), light buff-gray, banded with darker gray, with small disseminated crystals of calcite; lowest 6 inches more buff than rest of unit. Units 13 to 1 inclusive approximately equivalent to unit 4 of Stauffer (1915, p. 203). | 3 | 6 |
| 12. | Dolomite, dark gray to blackish-gray, with scattered crystals of calcite and grains of quartz sand | | 5 |
| 11. | Limestone (calcilutite), very light buff-gray, with disseminated small crystals of calcite, conchoidal fracture, and stylolites | 2 | 4 |
| 10. | Limestone (calcilutite), similar to unit 11, with some darker gray bands arranged parallel to bedding | 3 | |
| 9. | Limestone (calcilutite), light gray to light buff-gray, with conchoidal fracture | | 8 |
| 8. | Limestone, slightly dolomitic, buff to brown, medium to coarsely crystalline, with discontinuous thin bands of gray, finely crystalline limestone | | 9 |
| 7. | Limestone (calcilutite), buff-gray to light buff, with small scattered crystals of calcite and few grains of quartz sand; lowest 10 inches a calcarenite | 3 | |
| 6. | Limestone (calcilutite), light buff-gray banded with darker buff-gray | | 8 |
| 5. | Limestone (calcilutite), like unit 6 but with wider bands of color | 1 | 2 |
| 4. | Limestone (calcilutite), lighter buff-gray than unit 5, without color banding and with conspicuous conchoidal fracture | 1 | 10 |
| 3. | Limestone, light gray, with few small vugs of calcite, an earthy feel, and stromatoporoids | | 8 |
| 2. | Limestone (calcarenite), light gray, with small vugs lined with crystals of calcite; ? *Amphipora* sp. and athyrid | 1 | 11 |
| 1. | Limestone, very light buff-gray, with very few small crystals of calcite and few ostracods | 1 | 8 |
| | Total thickness | 28′ | 9″ |

(The biostromal unit here described as Unit 14 is discontinuous and grades laterally into an inter-reef unit with the same characteristics as Unit 15.)

DETROIT RIVER GROUP-LUCAS DOLOMITE

| | |
|---|---|
| Upper 5 to 6 feet exposed locally in quarry floor; remainder in walls of crusher pit. Units 1-14 of Ehlers, Stumm, and Kesling | 29′4″—29′7″ |
| Total thickness | 29′4″—29′7″ |




Text-fig. 1—Areal geologic map showing distribution of Devonian rocks, underlying Silurian and overlying Mississippian strata in parts of southeastern Michigan and northwestern Ohio. After Ehlers, Stumm, and Kesling (1951, Map 1).

A second, well-exposed section of the Anderdon Limestone is exposed in the abandoned quarry of the Solvay Process Company at Sibley, about 2 miles north of Trenton, Wayne County, Michigan. (See map, Text-Figure 1) The rocks of this quarry, which is now owned by the Detroit Edison Company, were described by Ehlers, Stumm, and Kesling (1951, pp. 14-17) as follows:

DUNDEE LIMESTONE

Exposed in walls of quarry

| Unit | Ft. | In. |
|---|---|---|
| Units 1-11 of Ehlers, Stumm, and Kesling | 70 | 5 |
| Total thickness | 70 | 5 |

DISCONFORMITY

DETROIT RIVER GROUP-ANDERSON LIMESTONE

Exposed in walls of quarry

| Unit | Ft. | In. |
|---|---|---|
| 8. Limestone, finely crystalline, very light gray, unfossiliferous except for few molds of a minute gastropod found near the top of the bed at some places in quarry; vertical joining and weathered light gray to white surfaces are conspicuous characteristics of unit | 2 | 4 |
| 7. Limestone, finer grained in lower and upper parts; coarser grained, with some frosted quartz grains in the middle part; buff. Many carbonaceous laminae in the upper and lower parts. Unfossiliferous | 4 | |
| 6. Limestone, finely crystalline, dark gray, 2 inches to 8 inches thick, containing small disseminated crystals of calcite. Unfossiliferous | | 8 |
| 5. Limestone, fine-grained, light gray, unfossiliferous | 4 | |
| 4. Limestone, granular, dark buff to brown at base to light buff-gray at top. Lowest 3 inches has many carbonaceous laminae. Above this is a band, 3 inches to 4 inches thick, which contains molds of newly described species including *Palaeozygopleura sibleyense* Linsley, n. sp., *Murchisonia (M.) sibleyensis* Linsley, n. sp., *Straparollus (Serpulospira) diversiformis* Linsley, n. sp., *Nodonema granulatum* Linsley, n. sp., and other species of gastropods. *Conocardium sibleyense* La Rocque, *Diodontopteria ehlersi* La Rocque and a few other pelecypods, cephalopods and brachiopods are associated with the gastropods. The gastropods and pelecypods are present above and below the 4 inch band but are less abundant. Most of the unit is characterized by a digitate *Favosites* and hemispherical and explanate stromatoporoids, in such abundance as to form a biostrome. A small coarsely plicate *Atrypa* is fairly common in the biostrome | 5 | 0 |
| 3. Limestone, granular, buff, composed of finely comminuted shells, locally cross-bedded in lower part. Contains many quartz grains, especially in the cross-bedded part. Unfossiliferous | 5 | 0 |

| Unit | Ft. | In. |
|---|---|---|
| 2. Limestone, fine-grained, light buff with numerous carbonaceous laminae. Unfossiliferous | | 3 |
| 1. Limestone, fine-grained, grayish buff separated into linear and wavy laminae by thin films of carbonaceous matter. Upper 3 inches has small areas of dark gray limestone, some of which simulate pebbles. Many stylolites. Unfossiliferous | 2 | 6 |
| Total thickness | 23′ | 9″ |

## DETROIT RIVER GROUP-LUCAS DOLOMITE

Exposed in wall of quarry, sunk in floor of quarry and walls of crusher pit.

| | | |
|---|---|---|
| Units 1-15 of Ehlers, Stumm and Kesling | 51 | 3 |
| Total thickness | 51′ | 3″ |

The Anderdon Limestone is exposed in the two France Stone Company's quarries, which are located just north of the village of Silica, Lucas County, Ohio, and about 2½ miles southwest of the business section of Sylvania, Ohio. The larger one of these quarries was designated the "East Quarry" by Ehlers, Stumm, and Kesling in figure 1, page 4 of their 1951 publication. The quarry, indicated in this figure, is bounded on the west by the north-south trending Centennial Road, on the south by the east-west directed Sylvania Avenue, and on the north by the east-west bearing Brint Road (see Text-figure 2). The eastern wall of the quarry is about ¼ mile east of Centennial Road. The smaller quarry, designated the "West Quarry" of the France Stone Company in Text-figure 2, is located on the western side of Centennial Road. It extends northward from Sylvania Avenue for a distance of about ½ mile, this northward extent being one-half that of the larger quarry. A recently made pit has been cut through the floor of the quarry about 1/5 mile north of Sylvania Avenue. Most of the rock taken from this pit is the Anderdon Limestone; this is hauled by trucks via a rock cut passageway beneath Centennial Road to a quarry road near the base of the west wall of the East Quarry, and thence transported to a crusher located about 1/10 mile south of Sylvania Avenue. Exposures of the Anderdon Limestone occur in most of

the west wall of the East Quarry, in the rock cut beneath Centennial Road, and in the walls of the pit of the West Quarry.

The areal distribution of the Anderdon Limestone and other Middle Devonian rocks of the Silica, Ohio, regions results from the erosion of the Lucas County monocline. The trend of the monocline is about N. 10° W.; the average dip of the strata in this structure is about 6° S. 80° W. As the result of erosion of the relatively high dipping beds, the various formations appear in narrow bands that are closely parallel to the strike of the monocline. The dip of the strata and the areal distribution of the formations are indicated by illustrations in the publication by Ehlers, Stumm, and Kesling (1951, pl. 2, fig. 2 and text-fig. 1).

The section of the Anderdon Limestone described by Ehlers, Stumm, and Kesling (1951, p. 5) is located in the west wall of the East Quarry of the France Stone Company and in a short continuation of this wall, extending southward from Sylvania Avenue to the rock crusher of this company. The contact between the Anderdon Limestone and the underlying Lucas Dolomite is well shown in the part of the wall south of Sylvania Avenue. The lowest unit of the Anderdon Limestone (unit 1 of Ehlers, Stumm, and Kesling, 1951, p. 5), exposed in wall south of Sylvania Avenue, contains many gastropods that are described in this paper.

At the time of publication of the paper by Ehlers, Stumm, and Kesling, the uppermost strata of the Anderdon Limestone were not exposed. As the result of the excavation of the pit in the West Quarry and the passageway connecting this pit with the East Quarry road, a complete section of the Anderdon Limestone became available for examination by the author.

At the time the author made the following description of the Anderdon section, the south wall of the pit and rock passageway were in alignment and successively higher beds of the Anderdon Limestone could be readily examined at pit-floor level as they dipped sharply to the southwest. During the last two years the south and north walls of the pit have been shattered by extensive quarrying; the continuity of the strata can now be recognized only on few occasions when the much disturbed rock of the walls and talus material have been removed.

## DUNDEE LIMESTONE

Exposed partly in pit walls and west wall of West Quarry of France Stone Company.

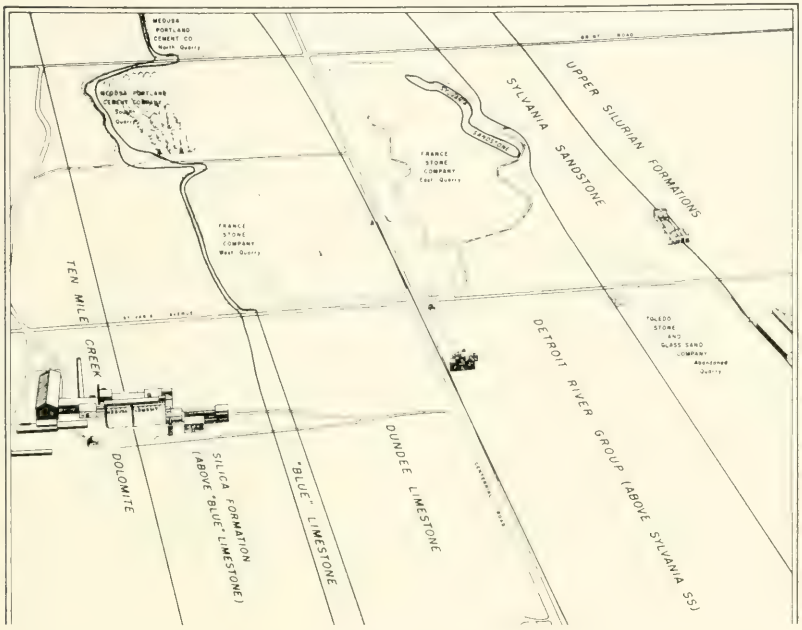
| | Ft. | In. |
|---|---|---|
| Limestone and dolomitic limestone—after Ehlers, Stumm, and Kesling (1951, pp. 17,18) | 61 | 5 |

## DETROIT RIVER GROUP-ANDERDON LIMESTONE

Exposed in south wall of pit in West Quarry of France Stone Company and in rock cut passageway beneath Centennial Road, about one-fifth mile north of Sylvania Avenue

| Unit | Ft. | In. |
|---|---|---|
| 12. Dolomite, light buff-gray, mottled with gray; prominent stylolite surface on uneven (?eroded) top of unit | 0 | 8 to |
| | 1 | 5 |
| 11. Dolomite, buff, medium crystalline, unfossiliferous | 3 | 1 |
| 10. Dolomite, mottled buff and gray, finely crystalline, unfossiliferous | | 8 |
| 9. Dolomite, buff with some streaks of gray, unfossiliferous | 6 | 2 |
| 8. Dolomite, gray, mottled with buff, finely crystalline, unfossiliferous | | 5 |
| 7. Dolomite, buff, finely to medium crystalline; lowest 12 inches light buff, mottled with gray; small, irregular, solution cavities | 6 | 6 |
| 6. Limestone, light gray to buff-gray, thinly bedded, unfossiliferous | 2 | 5 |
| 5. Limestone, buff-gray, laminated, with laminae contorted in upper part; unfossiliferous | 2 | 5 |
| 4. Dolomite, buff-gray to buff, very finely crystalline, filled wtih vugs and geodes of crystalline calcite; unfossiliferous | 2 | 8 to |
| | 4 | 5 |
| 3. Dolomite, light buff, fine-grained, and laminated; weathers into layers one to two inches in thickness | 1 | 5 |
| 2. Dolomite, dark buff to brown, crystalline, and thick bedded. Several species of *Murchisonia* and other high-spired gastropods occur sporadically in upper five to ten inches of this unit. Upper one foot of unit with considerable carbonaceous material | 4 | 10 to |
| | 5 | 3 |
| 1. Dolomite, light buff to buff-gray, with vugs of calcite crystals, molds of many small gastropods, and a small number of brachiopods, simple corals, and stromatoporoids. The most characteristic gastropods are *Microdoma tricarinata* (Grabau), *Paleozygopleura joanni* Linsley, n. sp., *Murchisonia (M.) anderdoniae* Linsley, n. sp., *Nodonema granulatum* Linsley, n. sp., *Straparollus (Serpulospira) diversiformis* Linsley, n. sp., and *Tropidodiscus vesculilineatus* Linsley, n. sp. Pelecypods are rarely found associated with these gastropods. The dolomite has a pertroliferous odor when struck with a hammer | 1 | 2 |
| Total thickness | 32′5″ to 35′4″ | |

According to Ehlers, Stumm, and Kesling (1951, pp. 5, 6) the Anderdon Limestone in the France Stone Company's quarries is underlain respectively by 83 feet and 9 inches to 84 feet and 1 inch of Lucas Dolomite, and 19 feet and 5 inches of Amherstburg Dolomite. In the east wall of the East Quarry, the Amherstburg Dolomite is underlain by about 15 feet of Sylvania Sandstone; in an abandoned quarry just south of Sylvania Avenue and about


MEDUSA PORTLAND CEMENT CO North Quarry
MEDUSA PORTLAND CEMENT CO West Quarry
FRANCE STONE COMPANY West Quarry
FRANCE STONE COMPANY East Quarry
SYLVANIA SANDSTONE
UPPER SILURIAN FORMATIONS
TEN MILE CREEK
TOLEDO STONE AND GLASS SAND COMPANY Abandoned Quarry
DETROIT RIVER GROUP (ABOVE SYLVANIA SS)
DUNDEE LIMESTONE
"BLUE" LIMESTONE
SILICA FORMATION (ABOVE "BLUE" LIMESTONE)
DOLOMITE

Text-fig. 2—Drawing made from an oblique aerial photograph of the Silica, Ohio, region to show aerial distribution of the Devonian formations and the main quarries in which they are exposed. Modified from Ehlers, Stumm, and Kesling (1951, fig. 1, p. 4).

one-fifth of a mile east of Centennial Road, 50 feet of Sylvania Standstone has been recognized (see Ehlers, Stumm, and Kesling 1951, p. 7).

The Anderdon Limestone of the Silica region is overlain respectively by the Middle Devonian Dundee Limestone, Silica Formation, and Ten Mile Creek Dolomite. The Dundee Limestone, which probably rests disconformably on the Anderdon Limestone, is well exposed in the West Quarry of the France Stone Company and in the "South" and "North Quarries" of the Medusa Portland Cement Company. (See Ehlers, Stumm, and Kesling, 1951, figure 1, p. 4 and pp. 17, 18.) The Dundee has a thickness in these quarries of 61 feet and 5 inches. (See Ehlers, Stumm, and Kesling, 1951, pp. 17, 18.)

The Anderdon rocks exposed in the quarries of the France Stone Company near Silica, Ohio, and the abandoned Solvay Process Company's quarry at Sibley are more closely related to each other in lithological character than they are to the Anderdon strata of the Brunner, Mond Canada Ltd. quarry about 1¼ miles northeast of Amherstburg, Ontario. Most of the rocks of the two first mentioned quarries are dolomites and dolomitic limestones; only a few thin beds in the Anderdon of the France Stone Company consist of high-calcium limestone. In the Brunner, Mond Canada Company Limited quarry most of the Anderdon is a high-calcium stone.

## STRATIGRAPHIC CORRELATION OF THE ANDERDON LIMESTONE

An examination of the geographic occurrences and stratigraphic relationships of the Anderdon Limestone is essential to an understanding of the stratigraphic correlation of this formation. At its type locality, the Brunner, Mond Canada Ltd. quarry in Anderdon Township, Essex County, Ontario, the Anderdon Limestone is overlain by the Dundee Limestone and underlain by the Lucas Dolomite. The records of deep wells in the quarry region show that the Lucas is underlain respectively by two older formations of the Detroit River Group, the Amherstburg Dolomite and Sylvania Sandstone. Beneath the Sylvania is a formation that for many years was known as the Onondaga Limestone but recently

designated the Bois Blanc Limestone by Canadian geologists, who recognized the continuity of the so-called Onondaga Limestone with the Bois Blanc strata of Michigan. In quarries along the Thames River Valley just east of Ingersoll, Ontario, situated about 115 miles east and 50 miles north of the type Anderdon locality, are exposures of high-calcium limestones that belong to the Amherstburg and Lucas Formations. In the quarry nearest to Ingersoll, the Lucas Limestone is disconformably overlain by strata composing the upper part of the Columbus Limestone, a formation which is older than the Dundee Limestone (see Ehlers and Stumm, 1951, pp. 1879-1888). The Anderdon Limestone seems to be absent in the Ingersoll region; if originally present, it has been removed by erosion prior to the deposition of the Columbus Limestone. Beneath the Detroit River rocks of the Ingersoll region is the Bois Blanc Limestone (formerly "Onondaga limestone"), outcrops of which occur at nearby places northeast of Ingersoll (see Ehlers and Stumm, 1951, fig. 1, pp. 1880, 1887). Somewhere between the Ingersoll region and Buffalo, New York, the Detroit River Group pinches out (see C. L. Stauffer, 1957, p. 382). Evidence for the eastward disappearance of the group is well indicated in quarries near Leroy, New York, located about 40 miles east of Buffalo, New York. In these quarries, strata of the upper part of the Columbus Limestone rest on beds of the Onondaga Limestone that contain the same fauna as the Bois Blanc Formation. From the preceding information it is obvious that the Anderdon Limestone and its associated formations composing the Detroit River Group are not present in New York.

The Amherstburg and Lucas Dolomites are exposed at several places in Ottawa, Erie, and Sandusky Counties, Ohio, which are adjacent or close to the south shore of Lake Erie. The outcrops, located on the east side of the Findlay arch limb of the Cincinnati geanticline, have been described by J. E. Carman (1927, p. 500-502). As in the Ingersoll, Ontario region, the Lucas strata are overlain by the Columbus Limestone. According to Carman *(op. cit.*, p. 502), "farther south along the east side of the anticline (Findlay arch) no outcrops of the Detroit River Formation are known. The formation is absent in central Ohio, in Delaware and Franklin counties, and it is probable that the members which exist

in Erie County thin out southward or are overlapped by the Columbus Limestone in northern Seneca County." Carman *(op. cit.*, p. 502) also reported the presence of several exposures of the Lucas Dolomite and one outcrop that is probably Amherstburg Dolomite around the base of the Bellefontaine outlier, which is located on the crest of the Cincinnati geanticline in Logan County about 80 miles southwest of Ottawa County. No occurrence of the Anderdon Limestone has been reported from this outlier or in Ottawa, Erie, and Sandusky Counties.

The Anderdon Limestone and its subjacent formations composing the Detroit River Group underlie a narrow belt of land extending from the Detroit region to quarries near Silica, Lucas County, Ohio. In the Detroit region the Sylvania Sandstone rests on the Bois Blanc Formation. Somewhere between this region and Lucas County, Ohio, the Bois Blanc pinches out; in this county the Sylvania Sandstone rests disconformably on the Upper Silurian Raisin River Dolomite. South of the Silica region, the Amherstburg Dolomite is overlapped by the Lucas Dolomite (see Carman, 1936, pp. 261-263, fig. 5 and Ehlers, Stumm, and Kesling, 1951, p. 23 and fig. 3). According to J. E. Carman (1927, p. 500) "no exposures of the Detroit River formation are known southwest of the crossing of the Maumee River," which is located about 19 miles southwest of Silica, Ohio. On a map, Carman (1927, Fig. 1, p. 482) indicated that the Amherstburg-Lucas (map legend) strata continue southwestward along the strike under a soil cover for a distance of about 20 miles from the Maumee River. Just how far the Anderdon Limestone exists south of the Silica, Ohio region, is unknown.

From the three preceding paragraphs it is obvious that the Anderdon Limestone is known only from exposures in Anderdon Township, Ontario, and in outcrops located in a narrow strip of land, extending from the Detroit region to Silica, Ohio. The limestone apparently does not extend far eastward into Ontario from Anderdon Township and without doubt is absent in New York State. Whether small extensions or erosional remnants of the Anderdon Limestone occur farther south in Ohio and possibly in Indiana and Illinois can only be determined from information derived from borings of deep wells.

The correlation of the Anderdon with other units of similar age remains an enigma, and the gastropods, because of their endemic nature, offer little aid in solving the problem. As a result of this survey of the gastropods, it would seem that one is probably dealing with a facies problem, and that the Anderdon is merely a localized expression of a unit that has different characteristics elsewhere. However, because of the limited outcrops available it is difficult at this point to ascertain the correlatives. The two most logical contenders for time equivalency are the Lucas Dolomite and the Columbus Limestone. As one proceeds downdip into the Michigan basin in the area of Detroit, Michigan, the Anderdon disappears quickly and the Lucas occupies an apparent analogous position, thus suggesting that the Anderdon is merely a near-shore equivalent of the Lucas beds. However, there is no paleontological evidence to support this conclusion. A more likely possibility is that the Anderdon is a reefward equivalent of the Columbus Limestone. This is suggested by occurrence in both formations of *Murchisonia (Hormotomina), Isonema,* and a few others. This problem certainly bears much further study before any conclusions can be reached, although it is essentially in agreement with the conclusions of Fagerstrom (1962, p. 430).

In a report on the fossil collections from the James Bay lowland, Dr. Alice E. Wilson (1953, pp. 76-81) presented evidence indicating the presence of a Bois Blanc fauna and apparently Detroit River and Dundee faunas in the James Bay region. The occurrence of the Bois Blanc fauna is definitely shown by Dr. Wilson's list of fossils *(op. cit.,* pp. 77-80), which includes the names of many species of corals, brachiopods, and trilobites characteristic of the Boic Blanc strata of Michigan and southwestern Ontario. The strata of the James Bay region containing the Bois Blanc fauna are in the lower part of the Abitibi River Formation. (See Martison, N. W., 1953, pp. 30-32 and fig. 2 - Correlation chart, facing p. 18). The middle and possibly some of the upper parts of the Abitibi River Formation contain strata having specimens of several Detroit River species. (See Martison, 1953, p. 34, and fig. 2; Wilson, 1953, p. 76.) According to Wilson (1953, p. 76) and Martison (1953, pp. 34, 35), beds in the higher portion of the

upper part of the Abitibi River Formation have examples of a few species that are indicative of the Dundee Limestone.

Two species of stromatoporoids that were first described from the James Bay region are now known to occur in the Anderdon Limestone. One of these, *Syringostroma aurorella,* originally described by Madeleine A. Fritz and R. H. Waines (1956, pp. 103, 104) from the Upper Abitibi River Formation at Coral Rapids on the Abitibi River of the James Bay lowland, was recently reported as occurring in the Anderdon Limestone (unit 14 of the described section) of the Brunner, Mond Canada Ltd. quarry of southwestern Ontario by Galloway and Ehlers (1960, pp. 93-95). The other stromatoporoid, *Syringostroma aurora,* was first described by W. A. Parks (1904, pp. 182, 183) from some exposures on the Kwataboahegan River, which joins the Moose River about 25 miles southwest of the point where this river empties into James Bay. Examination of map No. 1952-3, which accompanies a report by N. W. Martison (1953, map in separate map case), indicates that the strata of the outcrops along Kwataboahegan River are in the Upper Abitibi River Formation; according to the legend accompanying this map, the Upper Abitibi River Formation consists of Detroit River and ?Dundee strata. The discovery of *Syringostroma aurora* in the Anderdon Limestone of the Brunner, Mond Canada Ltd. quarry by Galloway and Ehlers (1960, pp. 82, 93) suggests that Park's specimen of this species probably was obtained from the strata of the Detroit River part of the Upper Abitibi River Formation that are correlative with the Anderdon Limestone.

It seems probable that the collection and identification of more fossils from the Middle and Upper Abitibi River Formation will show the existence of more Detroit River species in this formation. The occurrence of abundant molds of gastropods in yellowish brown limestone exposed along the Kwataboahegan River, noted by W. A. Parks (1904, pp. 180, 186), suggests the occurrence of gastropods in the Anderdon Limestone of southeastern Michigan and adjacent regions. Professor Parks *(op. cit.)* did not have time to make a thorough study of the gastropods along the Kwataboahegan River. When an intensive study is made, the gastropods may prove to be Anderdon or Lucas species.

Gastropods, which resemble those of the Anderdon Limestone, are present in the *Stringocephalus* zone of the Middle Devonian of Germany, which occupies a higher stratigraphic position in the Middle Devonian than the Anderdon Limestone. In this zone are *Straparollus (Serpulospira), Murchisonia (Murchisonia), Euryzone, Omphalocirrus, Naticopsis,* and other genera composing a gastropod assemblage that is much like that of the Anderdon Limestone.

## OCCURRENCE OF GASTROPODS

The gastropods from the Anderdon Limestone of the East Quarry of the France Stone Company were collected from unit 1 of the described section of this formation. This unit, described in this paper, has a thickness of 14 inches and rests on the Lucas Dolomite. The gastropods are associated with a proetid trilobite, orthoconic nautiloids, a few pelecypods, some simple corals and stromatoporoids, and four or five species of brachiopods.

The gastropods from the Anderdon Limestone of the abandoned Solvay Process Company's quarry at Sibley were collected from unit 4 of the described section of this limestone. Most of the specimens were obtained from a band of dolomitic limestone 3 to 4 inches thick located about 3 inches above the base of unit 4, which is 7 feet and 10 inches above the contact of the Anderdon with the underlying Lucas Dolomite. The gastropods in this band are associated with many specimens of *Conocardium sibleyense* La Rocque and *Diodontopteria ehlersi* La Rocque, and few specimens of other pelecypods and cephalopods. Most of the species of gastropods, pelecypods, and cephalopods of this band seem to be represented by specimens in lower and higher parts of unit 4.

Unit 4 of the Sibley Quarry is essentially a stromatoporoid-coral biostrome. It is characterized by numerous large hemispherical and explanate stromatoporoids, and less numerous specimens of a digitate *Favosites,* simple and compound tetracorals, a small costate *Atrypa,* and other brachiopods. The stromatoporoids and corals probably served as protection to the small gastropods, pelecypods, cephalopods, and brachiopods which lived on the bottom areas between them.

The gastropods of the Anderdon Limestone of the Brunner,

Mond Canada Ltd. quarry about 1¼ miles northeast of Amherstburg, Ontario, were obtained from units 14, 15, and 16 of this formation as it appears in this quarry. Unit 14, like unit 4 of the Sibley quarry, is a biostrome composed largely of stromatoporoids and corals. Locally in the Brunner, Mond Canada Ltd. quarry, unit 14 contains small, low bioherms. The gastropods, pelecypods, and brachiopods of unit 14, like those of unit 4 at Sibley, apparently lived in a protected environment on bottom areas between the masses of stromatoporoids and corals. Unit 15 of the same quarry contains a considerable number of relatively large high and low-spired gastropods and few small gastropods, stromatoporoids, and corals. Unit 16 has representatives of the high and low-spired gastropod species of unit 15 and many specimens of a large, discoid, septate gastropod. The gastropods of units 15 and 16 are not associated with numerous stromatoporoids and corals as are those of unit 14. They apparently lived on a sea-bottom on which very fine calcareous sediments were accumulating. Most of the material of these sediments may have been derived from the comminution of the hard part of stromatoporoids, corals, and other invertebrates and subsequently deposited in water having a depth slightly greater that that of the habitat of the stromatoporoids, corals and other invertebrates.

The accompanying Tables indicate the distribution by species of the Anderdon gastropods in the three quarries. Table No. 1 illustrates a numerical count of all identifiable specimens in the collection of the Museum of Paleontology at the University of Michigan. Table 2 represents the percentile composition of the fauna from each individual quarry. In this chart each species is expressed as its percentage of the total number of specimens found in a given quarry. Thus the abundance of a species compared to the total number of specimens in a quarry can be readily noted. In both charts the first vertical column to the right of the specific name represents the species in the France Stone Company quarry. The second column represents the Sibley quarry, the third vertical column unit 14 of the Brunner Mond Canada Ltd. quarry, and the fourth column units 15-16 of the Brunner, Mond Canada Ltd. quarry. The gastropods of unit 14 and units 15-16 of the Brunner,

TABLE 1 — NUMERICAL COUNT

| Species | France | Sibley | Brunner Unit 14 | Brunner Unit 15-16 | Total |
|---|---|---|---|---|---|
| *Tropidodiscus vesculilineatus* | 45 | 0 | 0 | 0 | 45 |
| *T. compticarinatus* | 0 | 1 | 0 | 0 | 1 |
| *T. cultricarinatus* | 0 | 0 | 10 | 0 | 10 |
| *Bellerophon (B.) stummi* | 5 | 0 | 0 | 0 | 5 |
| *Tylozone commensurata* | 0 | 0 | 3 | 40 | 43 |
| *T. turricula* | 0 | 0 | 0 | 5 | 5 |
| *Tylozone* sp. | 0 | 0 | 0 | 1 | 1 |
| *Zalozone lacunata* | 0 | 0 | 0 | 4 | 4 |
| *Zalozone* cf. *Z. lacunata* | 0 | 0 | 0 | 1 | 1 |
| *Nodonema granulatum* | 74 | 424 | 5 | 0 | 503 |
| *Euryzone petilitornata* | 32 | 13 | 32 | 23 | 100 |
| *E. latitornata* | 0 | 6 | 0 | 0 | 6 |
| *E. pharkidopyndax* | 0 | 1 | 0 | 0 | 1 |
| *Euryzone* ? sp. A | 0 | 0 | 0 | 24 | 24 |
| *Euryzone* ? sp. B | 0 | 0 | 0 | 8 | 8 |
| *Coelozone fasciata* | 0 | 0 | 1 | 0 | 1 |
| *Catischisma* ? sp. | 0 | 0 | 0 | 1 | 1 |
| *Mourlonia* ? sp. | 1 | 0 | 0 | 0 | 1 |
| *Ehlersina abditinoda* | 0 | 0 | 0 | 50 | 50 |
| *E. paucinodosa* | 0 | 0 | 0 | 10 | 10 |
| *Ehlersina* sp. | 0 | 0 | 0 | 1 | 1 |
| *Murchisonia (M.) akidota* | 0 | 15 | 5 | 0 | 20 |
| *M. (M.) anderdoniae* | 159 | 3 | 3 | 0 | 165 |
| *M.* sp. cf. *M. (M.) anderdoniae* | 9 | 1 | 0 | 0 | 10 |
| *M. (M.) gracilicrista* | 7 | 3 | 0 | 0 | 10 |
| *M. (M.) sibleyensis* | 37 | 26 | 1 | 0 | 64 |
| *M.* sp. cf. *M. (M.) sibleyensis* | 10 | 1 | 3 | 0 | 14 |
| *M. (M.) deludisubzona* | 0 | 3 | 0 | 0 | 3 |
| *M. (Hormotomina) penduliobesa* | 0 | 2 | 2 | 0 | 4 |

| Species | France | Sibley | Brunner Unit 14 | Brunner Unit 15-16 | Total |
|---|---|---|---|---|---|
| *Crenulazona angulata* | 3 | 6 | 1 | 47 | 57 |
| *Loxoplocus (Donaldiella)* sp. | 1 | 0 | 0 | 0 | 1 |
| *Mesocoelia obstipisutura* | 9 | 2 | 0 | 0 | 11 |
| *Cerithioides incomptum* | 0 | 33 | 5 | 0 | 38 |
| *Straparollus (Serpulospira) diversiformis* | 36 | 30 | 9 | 1 | 76 |
| *Straparollus (Euomphalus)* sp. A. | 0 | 0 | 0 | 1 | 1 |
| *Straparollus (Euomphalus)* sp. B | 0 | 0 | 0 | 1 | 1 |
| *Straparollus (Euomphalus)* sp. C | 0 | 0 | 0 | 1 | 1 |
| *Omphalocirrus* sp. | 0 | 1 | 0 | 0 | 1 |
| *Microdoma tricarinatus* | 135 | 0 | 0 | 0 | 135 |
| *Pagodea falcatinoda* | 0 | 1 | 0 | 0 | 1 |
| *Copidocatomus collarus* | 0 | 0 | 2 | 0 | 2 |
| *Isonema ? corrugata* | 2(?) | 1 | 0 | 0 | 1(+2?) |
| *Scalactrochus fragosus* | 0 | 0 | 0 | 18 | 18 |
| *Platyceras (Platyceras)* sp. | 0 | 0 | 0 | 1 | 1 |
| *Palaeozygopleura sibleyense* | 5 | 145 | 0 | 0 | 150 |
| *P. joanni* | 70 | 10 | 0 | 0 | 80 |
| *Streptacis ?* sp. | 1 | 0 | 0 | 0 | 1 |
| *Naticopsis (N.) pegmihumerosa* | 0 | 0 | 0 | 3 | 3 |
| *N. (N.) opimavoluta* | 0 | 0 | 0 | 8 | 8 |
| *N. (N.) planifrons* | 0 | 0 | 0 | 7 | 7 |
| *Turbonitella trunculinoda* | 0 | 2 | 1 | 0 | 3 |
| | 716 | 885 | 83 | 256 | 1940 |

TABLE 2 — RELATIVE FREQUENCY OF OCCURRENCE PER QUARRY

| Species | France | Sibley | Brunner Unit 14 | Brunner Units 15-16 | Total |
|---|---|---|---|---|---|
| *Tropidodiscus vesculilineatus* | 6.28% | 0. 0% | 0. 0% | 0. 0% | 2.31% |
| *T. compticarinatus* | 0. 0% | 0.11% | 0. 0% | 0. 0% | 0.05% |
| *T. cultricarinatus* | 0. 0% | 0. 0% | 12.05% | 0. 0% | 0.51% |
| *Bellerophon (B.) stummi* | 0.70% | 0. 0% | 0. 0% | 0. 0% | 0.25% |
| *Tylozone commensurata* | 0. 0% | 0. 0% | 3.61% | 15.62% | 2.21% |
| *T. turricula* | 0. 0% | 0. 0% | 0. 0% | 1.95% | 0.25% |
| *Tylozone* sp. | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *Zalozone lacunata* | 0. 0% | 0. 0% | 0. 0% | 1.56% | 0.20% |
| *Z.* cf. *Z. lacunata* | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *Nodonema granulatum* | 10.33% | 45.65% | 6.02% | 0. 0% | 25.92% |
| *Euryzone petilitornata* | 4.47% | 1.44% | 38.55% | 8.98% | 5.15% |
| *E. latitornata* | 0. 0% | 0.68% | 0. 0% | 0. 0% | 0.30% |
| *E. pharkidopyndax* | 0. 0% | 0.11% | 0. 0% | 0. 0% | 0.05% |
| *Euryzone* ? sp. A | 0. 0% | 0. 0% | 0. 0% | 9.36% | 1.23% |
| *Euryzone* ? sp. B | 0. 0% | 0. 0% | 0. 0% | 3.12% | 0.41% |
| *Coelozone fasciata* | 0. 0% | 0. 0% | 1.20% | 0. 0% | 0.05% |
| *Catischisma* ? sp. | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *Mourlonia* ? sp. | 0.14% | 0. 0% | 0. 0% | 0. 0% | 0.05% |
| *Ehlersina abditinoda* | 0. 0% | 0. 0% | 0. 0% | 19.53% | 2.57% |
| *E. paucinodosa* | 0. 0% | 0. 0% | 0. 0% | 3.90% | 0.51% |
| *Ehlersina* ? sp. | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *Murchisonia (M.) akidota* | 0. 0% | 1.67% | 6.02% | 0. 0% | 1.02% |
| *M. (M.) anderdoniae* | 22.21% | 0.34% | 3.61% | 0. 0% | 8.51% |
| *M.* cf. *M. (M.) anderdoniae* | 1.26% | 0.11% | 0. 0% | 0. 0% | 0.51% |
| *M. (M.) gracilicrista* | 0.98% | 0.34% | 0. 0% | 0. 0% | 0.51% |
| *M. (M.) sibleyensis* | 5.19% | 2.88% | 1.20% | 0. 0% | 3.29% |

| Species | France | Sibley | Brunner Unit 14 | Brunner Units 15-16 | Total |
|---|---|---|---|---|---|
| *M.* cf. *M. (M.) sibleyensis* | 1.40% | 0.11% | 3.61% | 0. 0% | 0.72% |
| *M. (M.) deludisubzona* | 0. 0% | 0.34% | 0. 0% | 0. 0% | 0.15% |
| *M. (Hormotomina) penduliobesa* | 0. 0% | 0.23% | 2.40% | 0. 0% | 0.20% |
| *Crenulazona angulata* | 0.42% | 0.68% | 1.20% | 14.84% | 2.93% |
| *Loxoplocus (Donaldiella)* sp. | 0.14% | 0. 0% | 0. 0% | 0. 0% | 0.05% |
| *Mesocoelia obstipisutura* | 1.26% | 0.23% | 0. 0% | 0. 0% | 0.56% |
| *Cerithioides incomptum* | 0. 0% | 3.73% | 6.02% | 0. 0% | 1.91% |
| *Straparollus (Serpulospira) diversiformis* | 5.05% | 3.39% | 10.82% | 0.39% | 3.91% |
| *Straparollus (Euomphalus)* sp. A | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *S. (Euomphalus)* sp. B | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *S. (Euomphalus)* sp. C | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *Omphalocirrus* sp. | 0. 0% | 0.11% | 0. 0% | 0. 0% | 0.05% |
| *Microdoma tricarinatus* | 18.85% | 0. 0% | 0. 0% | 0. 0% | 6.95% |
| *Pagodia falcatinoda* | 0. 0% | 0.11% | 0. 0% | 0. 0% | 0.05% |
| *Copidocatomus collarus* | 0. 0% | 0. 0% | 2.40% | 0. 0% | 0.10% |
| *Isonema ? corrugata* | (?) 0.28% | 0.11% | 0. 0% | 0. 0% | 0.05% (?0.15%) |
| *Scalactrochus fragosus* | 0. 0% | 0. 0% | 0. 0% | 7.03% | 0.92% |
| *Platyceras (Platyceras)* sp. | 0. 0% | 0. 0% | 0. 0% | 0.39% | 0.05% |
| *Palaeozygopleura sibleyense* | 0.70% | 16.38% | 0. 0% | 0. 0% | 7.73% |
| *P. joanni* | 9.77% | 1.13% | 0. 0% | 0. 0% | 4.00% |
| *Streptacis* ? sp. | 0.14% | 0. 0% | 0. 0% | 0. 0% | 0.05% |
| *Naticopsis (N.) pegmihumerosa* | 0. 0% | 0. 0% | 0. 0% | 1.17% | 0.15% |
| *N. (N.) opimavoluta* | 0. 0% | 0. 0% | 0. 0% | 3.12% | 0.41% |
| *N. (N.) planifrons* | 0. 0% | 0. 0% | 0. 0% | 2.73% | 0.36% |
| *Turbonitella trunculinoda* | 0. 0% | 0.23% | 1.20% | 0. 0% | 0.15% |
| Total (specimens per quarry/all specimens) | 36.91% | 45.61% | 4.33% | 13.19% | |

Mond Canada Ltd. quarry were tabulated separately because of the great dissimilarity between the faunas of these units.

Obviously such a table contains many figures which may be misleading. Species of which only one or two specimens were collected can hardly be regarded as being significant. The author does not believe that the present ratios of the occurrence of species found in the Brunner, Mond Canada Ltd. quarry would be maintained if as large a collection of specimens were available as is the case in the other two quarries. Nevertheless, many interesting observations can be noted from the distribution of specimens available.

Units 15 and 16 of the Brunner, Mond quarry contain an assemblage of relatively large gastropods preserved in a fine calcilutite whereas all of the other gastropods are small forms preserved in a biostromal aggregation of other fossils. Most of the young individuals of the larger species are found in the biostromal units (especially the biotstromal unit at the Brunner Mond Canada Ltd. quarry); the adults of the larger species are restricted to units 15 and 16 of the Brunner, Mond Canada Ltd. quarry. Eighty-two per cent of the species found in units 15 and 16 are restricted to these units; nine per cent of the unrestricted species, consisting of immature specimens, are found in the biostromal units of the Brunner, Mond quarry and the other quarries.

Of the 50 species of gastropods discussed in this paper, 36 per cent are represented in the France Stone Company quarry, 44 per cent in the Sibley quarry, 20 per cent in unit 14 of the Brunner, Mond Canada Ltd. quarry and 44 per cent in units 15-16 of the Brunner, Mond Canada Ltd. quarry. Of the 18 species found in the France Stone Company quarry, six are restricted to that quarry. Six of the 22 species found in the Sibley quarry are found only at that locality. At the Brunner, Mond Canada Ltd. quarry three out of 15 species are limited to unit 14 and 18 out of 22 species are found only in units 15-16. This distribution of species is one of the best examples of the effect of environment on faunal composition. Units 15-16 of the Brunner, Mond Canada Ltd. quarry lie directly on the biostromal unit 14, yet their gastropod faunas show only the slightest similarity. The inferred environments of these units will be treated more fully in this paper under the heading of "Paleoecology."

Only three species of gastropods have been found in all the

gastropod-bearing beds of the Anderdon beds described in this paper. Two of these species are the variable and presumably adaptable *Euryzone petilitornata* Linsley, n. sp. and *Straparollus (Serpulospira) diversiformis* Linsley, n. sp. The adults of the third species, *Crenulazona angulata* Linsley, n. sp., are restricted to units 15-16 of the Brunner, Mond Canada Ltd. quarry, but only young individuals have been found in the biostromal units, and one adult specimen found on a loose block of rock in the Sibley quarry.

Species that have been found in all three biostromal units are *Nodonema granulatum* Linsley, n. sp., *Murchisonia (Murchisonia) anderdoniae* Linsley, n. sp., and *Murchisonia (Murchisonia) sibleyensis* Linsley, n. sp.

Though there are many species known only from a single quarry, the apparent absence of a species from a particular quarry may be due to insufficient collecting. Nevertheless there are some striking examples of restriction. The first is the restriction of the species of the genus *Tropidodiscus*. Three species of this genus have been named and each species is limited in occurrence to one quarry. Other species which show fairly good evidence of restriction are *Bellerophon* (B.) *stummi* Linsley, sp. nov. and *Euryzone latitornata* Linsley, n. sp. (See Table 1.) The most striking example is shown by Grabau's species *Microdoma tricarinata* (Grabau) which was originally described from a specimen found in the Detroit salt shaft. One hundred and thirty-five specimens of this species were found in the France Stone Company quarry, comprising almost one-fifth of all of the gastropods found there. Not a single specimen of this species was found in the Sibley or Brunner, Mond Canada Ltd. quarries, both of which are much closer to the Detroit salt shaft than the France Stone Company quarry. (See Table 1.)

The gastropod faunas of the biostromal units of the three quarries are different; the significance of these differences is difficult to determine. The dissimilarity of the faunas could be due to temporal evolution or spatial isolation. If spatial isolation, accomplished by discontinuous biostromal horizons, is the cause, it would be expected that geographical proximity would be reflected in faunal similarity. However, such is not the case. The Brunner, Mond Canada Ltd. quarry is located about six miles from Sibley,

Michigan, and the France Stone Company quarry is about 40 miles away from the other two. (See map, Text-figure 1.) The faunal similarities are greatest between the France Stone Company quarry and Sibley quarry and not so great as between either of these quarries and Brunner, Mond Canada Limited quarry. France Stone Company and Sibley quarries have 12 species in common and are especially characterized by the great abundance of *Nodonema granulatum* Linsley, n. sp., *Paleozygopleura,* and *Murchisonia (Murchisonia) sibleyensis* Linsley, n. sp. The France Stone Company quarry and Brunner, Mond Canada Ltd. quarry have only seven species in common; all of these, except the common *Euryzone petilitornata* Linsley, n. sp. and *Straparollus (Serpulospira) diversiformis* Linsley, n. sp., are characterized by being rare in one quarry and fairly common in the other. Sibley quarry has 11 species in common wtih the Brunner, Mond Canada Ltd. quarry.

From the above observations it is evident that the faunal similarities do not closely approximate the geographical relationships of the biostromal units of the three quarries. Sibley quarry appears to have a fauna that is intermediate in character to those of the France Stone Company quarry and the Brunner, Mond Canada Ltd. quarry The gastropod unit at Sibley quarry also has an intermediate stratigraphic position; it is in the lower middle part of the quarry section and thus stratigraphically closer to unit 1 of the France Stone Company than it is to unit 14 of Brunner, Mond Canada Ltd. quarry. Likewise, the gastropod fauna of the Sibley quarry bears a somewhat closer resemblance to the fauna of the France Stone Company quarry than it does to that of the Brunner, Mond Canada Ltd. quarry, even though Sibley quarry is geographically closer to Brunner, Mond Canada Ltd. than to the France Stone Company quarry.

From the preceding discussion the author concludes that the observed faunal differences are more likely due to temporal evolution than to spatial isolation. Further field work, however, should be done to verify this conclusion. Most of the gastropods in the collection at the University of Michigan were gathered from loose blocks blasted from the quarry face. Collecting from the quarry faces is both difficult and hazardous, but if careful collections could

be made layer by layer, it is probable that further significant differences in faunal assemblages would be found. A collection of this type has been started, but the results of the study will have to await publication of a subsequent paper.

## PALEOECOLOGY

The sediments of the Anderdon Limestone and their contained faunas show evidence of two primary ecological settings favorable to habitation by gastropods; one a "biostromal" habitat, the other an "inter-reef" habitat. Most of the rock units of the Anderdon lack fossil remains; a few units contain large local biostromal aggregations of corals, stromatoporoids, brachiopods, pelecypods, cephalopods, and gastropods. All three quarries visited by the author have a "biostromal" unit from which gastropod faunas were obtained, but each of these units is distinctive. Unit 1 of the France Stone Company contains the most poorly developed "biostrome." Corals and stromatoporoids are comparatively rare here and the gastropods comprise about 5 per cent of the recognizable fauna; brachiopods are fairly common and pelecypods are almost nonexistent. It is possible that the corals and stromatoporoids were rendered unrecognizable by dolomitization. However, the author feels that these two groups were never as important elements of the ecological setting here as in the other two quarries. The scarcity of pelecypods and abundance of brachiopods suggests that the substrate of unit 1 consisted of coarse material, and thus may be indicative of moderately deep water. It is problematical just how much transportation this assemblage has undergone. It seems probable that some transportation occurred; the skeletal remains could not have been carried far, because they are fragile, finely ornamented, and show no effects of abrasion.

The "biostrome" bed at Sibley (unit 4) differs from that of the France Stone Company quarry in many respects. It is composed largely of stromatoporoids and favositid corals and thus represents a true biostrome rather than the more coquina-like nature of the France Stone Company bed. The coral-stromatoporoid bed is one of three distinct lithologic facies which make up

unit 4. A second facies consists of many carbonaceous laminae spaced from an eighth of an inch to one inch apart. The surface of each lamina is covered with a multitude of badly crushed shells of an atrypoid brachiopod. Gastropods have never been found on these carbonaceous laminae though a few have been found in the limestone between the laminae. The gastropods are found most abundantly in the third lithologic facies which directly overlies the carbonaceous laminae. The limestone of this third facies is fine-grained and light buff gray; it occurs as the matrix for the coral-stromatoporoid assemblage. It is not known that the gastropods lived among the stromatoporoids and corals; they probably lived on the fine muds that were deposited amid the biostrome.

Aside from the lithologic differences noted in Sibley and France Stone Company quarries, there are also faunal differences; the differences in the gastropod faunas have already been discussed. The most striking faunal difference is the abundance of pelecypods at Sibley quarry. Both *Diodontopteria ehlersi* La Rocque and *Conocardium sibleyense* La Rocque are common and attest to the soft, muddy nature of the sea bottom at this locality. It seems doubtful that this fauna has undergone any great amount of transportation, because the preservation of fine ornamentation of the invertebrates is relatively good and shows little evidence of abrasion.

The "biostromal" unit of the Brunner, Mond Canada Ltd. quarry (unit 14) is distinct from each of the other two "biostrome" units of the Anderdon Limestone and the most deserving of the term "biostrome." The entire unit, which is almost five feet thick, is locally a solid mass of stromatoporoids and corals. The snails are distributed among these corals and stromatoporoids and are relatively a small per cent of the total fauna. As in the France Stone Company quarry, pelecypods are scarce. *Diodontopteria* and *Conocardium* are rare in this unit. Apparently the gastropods lived among the corals and stromatoporoids and particularly on the mud flats which are found interspersed within the biostrome.

Though it is difficult to evaluate the significance of the small differences between these biostromal units, basically they all represent relatively shallow-water deposits wherein the small snails sought refuge and protection amid the corals and stromatoporoids.

Most of the snails appear to have lived on the mud flats within the biostrome where they fed as scavengers or, like the modern pleurotomarians, lived on algae that may also have lived in the intra-reef mud flats.

In sharp contrast to these biostromal units are units 15 and 16 Brunner, Mond Canada Ltd. quarry which I have tentatively labeled "inter-reef" units. Locally unit 15 contains large quantities of tetracorals, particularly *Cystiphylloides* sp. These coral assemblages are localized. Gastropods are rare or absent in these assemblages. The limestone surrounding these coral patches is a fine-grained, high-calcium calcilutite. In addition to the corals, the fauna is composed primarily of large gastropods (one to five inches in maximum dimension), a few orthoceraconic and breviconic nautiloids, some articulate brachiopods, and a variety of ostracods. These invertebrates and their enclosing sediments suggest a shallow inter-reef habitat where wave action was kept minimal by the sheltering action of the reefs. It is doubtful that turbulence could have been appreciable, for the aspidobranch gills of these gastropods were probably not able to tolerate more than occasional periods of excessive turbulence.

Unit 16 of the Brunner, Mond Canada Ltd. quarry offers a variation from unit 15. This thin bed (six inches) has a fauna comprised almost solely of the large, flat gastropods *Euryzone* ? sp. A. and *Euryzone* ? sp. B and a few representatives of gastropods characteristic of unit 15. The upper surface of unit 16 is covered with large mud cracks which have been filled with the basal sandy line of the Dundee Limestone. Most of the large individuals of *Euryzone* ? are found spire downward on this upermost surface. This bed obviously represents near-shore, lime mud flats and the fauna has without doubt been re-worked by wave action; however, the author doubts that these species lived far from their burial grounds. The scarcity of other invertebrates suggests that these species of *Euryzone* ? were well adapted to this near short life.

## PRESERVATION AND PREPARATION OF MATERIALS

With a few exceptions the gastropods of the Anderdon Limestone are preserved as natural external molds. Most of these molds,

especially those from the Brunner, Mond Canada Ltd. quarry near Amherstburg, Ontario, were filled to various degrees with calcite crystals. The calcite crystals were removed with the aid of dental tools and steel needles mounted in a vibrotool. Large gastropods from Brunner, Mond Canada Ltd. quarry presented an additional problem of preparation. Most of these large snails had a steinkern, which apparently had undergone at least partial lithification prior to the removal by solution of the shells. In some of these large snails the steinkern then slumped against one side of the mold and subsequently became fused to the mold by a later growth of calcite. The degree of fusion of the steinkern to the mold depended on the area of contact between the two and also the degree of devlopment of the secondary calcite crystals. In many specimens the amount of fusion was so slight that the steinkern readily separated from the mold with little obliteration of the sculpture shown by the mold. In other cases the fusion was so great that it is impossible to separate the steinkern from the mold and thus one-half of many molds were destroyed.

The amount of crystal growth within the molds varies considerably. In general the specimens from the quarry at Sibley, Michigan, exhibit the best preservation. The molds here occur in a finely crystalline limestone; they rarely have any considerable development of secondary calcite. The molds in the France Stone Company quarries are found in a more porous limestone and the molds commonly are lined with small calcite crystals. Fortunately these are easily removable; the crystallization and the removal of the crystals rarely affects the quality of preservation of the molds.

The amount of secondary calcite is particularly variable in the Brunner, Mond Canada Ltd. quarry, especially in the inter-reef unit where the large gastropods abound. Some molds were almost completely devoid of calcite whereas in other molds the crystals form such a solid mass as to make a natural cast of crystalline calcite. The amount of calcite varies spatially within the quarry so that in some places the molds are clean and at other places they are so extensively filled that the molds cannot be cleaned.

With few exceptions all of the specimens were collected from loose blocks found on the quarry floor. This was particularly neces-

sary in the case of the Brunner,Mond Canada Ltd. quarry where the gastropod zone occurs well above the quarry floor and is almost inaccessible.

After the molds were carefully prepared they were filled with Permamold, a latex molding compound. For the smaller specimens a single coating of latex was sufficient. For the larger specimens many coats were applied with an appropriate period of drying between successive coats. The accuracy in preserving detail of the latex appears to be good, added to which is the fact that it undergoes only a minimum amount of shrinkage. If greater magnification than 10x is used the grain of the latex becomes apparent and begins to detract from the detail of the specimen. No trouble was encountered with the size-range of material that is discussed in this paper. It is the author's opinion that the latex is of little use for any gastropods less than five mm. in greatest dimension.

The preparation of the plates was done by the author through means of facilities extended him by the University of Michigan Museum of Paleontology. Where it was feasible, standard lighting was used with the high-light in the upper left-hand corner. Unorthodox lighting was deemed necessary to emphasize particular features of certain specimens. Although the latex used to make the casts is uniformly white or buff, a coating of ammonium chloride was applied prior to photographing the specimen for the sake of emphasizing fine features of sculpture. For a few, lamp black or black indelible ink was mixed with the latex so that the application of the ammonium chloride would provide vivid contrast; this procedure was found to be unnecessary for most molds. Experiments were made with various shades of latex. It was found that most indelible inks would provide most any desirable hue with no apparent ill effects to the latex. However, there were few molds with sculptural relief so low that they could not be satisfactorily photographed with white latex. For the most part the coloring was unnecessary.

The systematic descriptions were patterned after the style set by Knight (1941, pp. 15, 16) and followed by Yochelson (1956). The descriptions basically include a general description of the shell, followed by a detailed description of the apex, whorl shape, base and umbilicus, aperture, and ornamentation. Owing to imperfect preser-

vation of the specimens, most observations concerning the aperture had to be derived from a description of the growth lines.

All types and figured specimens referred to in this manuscript have been catalogued and stored at the Museum of Paleontology of the University of Michigan.

## SYSTEMATIC DESCRIPTIONS

Phylum MOLLUSCA Cuvier
Class GASTROPODA Cuvier
Subclass PROSOBRANCHIA Milne Edwards
Order ARCHAEOGASTROPODA Thiele
Suborder BELLEROPHONTINA Ulrich and Scofield

Superfamily **BELLEROPHONTACEA** M'Coy, 1851
Family **BELLEROPHONTIDAE** M'Coy, 1851
Subfamily **TROPIDODISCINAE** Knight, 1956
Genus **TROPIDODISCUS** Meek and Worthen, 1866

*Tropidodiscus* Meek and Worthen, 1886, p. 160.

*Type species.* — *Bellerophon curvilineatus* Conrad, 1842, p. 269, by original designation of Meek and Worthen.

**Tropidodiscus vesculilineatus** Linsley, n. sp. Pl. 25, figs. 4a-c

*Tropidodiscus* sp. Ehlers, Stumm, and Kesling, 1951, pl. 3, fig. 23.

*Description.* — Shell small, composed of two to three whorls, isostrophic, doubly phaneromphalous with a sharply angular dorsum; whorls adpressed; whorl profile subhastate; whorl face sloping sharply laterad with gentle concavity from a poorly defined, narrow selenizone at the periphery, to a convexly rounded, dorso-laterally situated shoulder, thence continuing with moderate convexity to the umbilical shoulder; whorl face reflexed at umbilical shoulder and slightly overhanging on the umbilical slope; umbilical sutures sharply incised and moderately deep; umbilici moderately wide; ornamentation consisting of irregularly spaced costae at wide intervals; costae more widely spaced dorso-laterally than ventrally; costae most strongly developed ventrally, not extending past dorso-lateral shoulder; shell structure unknown. The holotype is about 7 mm in diameter and 2.8 mm in thickness.

*Remarks.* — This species is known only from the molds of the external surface of the shell. The imperfect preservation and the lack of specimens showing the apertural border make it impossible to de-

termine the exact character of the outer and parietal lips, although something of their configuration may be approximated from a study of the growth lines.

The species resembles in general form and ornamentation the type species of *Tropidodiscus, T. curvilineatus* (Conrad), from the Middle Devonian Onondaga Limestone of Schoharie, New York. It differs from the latter in having the diameter of the shell equal to one-fourth that of *T. curvilineatus* (Conrad) and in having the whorl face between the selenizone and dorso-laterally situated shulder slightly concave instead of slightly convex as exhibited by the similar part of the whorl face of the type species. The ornamentation differs from that of *T. curvilineatus* in having the costae and the interspaces between the costae much broader in comparison to the size of the shell.

The species is known from 45 specimens collected from the France Stone Company quarry near Sylvania, Ohio. It is the only species of *Tropidodiscus* obtained from this quarry and appears to be restricted to the lower beds of the Anderdon Limestone. The species is somewhat variable, though most, but not all variations, are due to age. The costae of most young shells are distinct and broad, whereas those of old shells are fine and often disappear completely on the final whorl. The ornamentation is always most pronounced on the umbilical shoulder and gradually disappears as the dorso-lateral shoulder is reached. In most shells, especially adults, the dorso-lateral shoulder is pronounced; three specimens lack this shoulder and have a uniformly rounded whorl face from the umbilical shoulder to the selenizone. In lacking a dorso-lateral shoulder these specimens resemble *T. cultricarinatus,* n. sp. However, I have tentatively included these three individuals in *T. vesculilineatus,* n. sp. because their shell sculpture resembles that of this species more strongly than that of *T. cultricarinatus,* n. sp.

A unique feature of *T. vesculililineatus,* n. sp. is exhibited by the holotype (see Pl. 25, fig. 4a). The external mold of the holotype has a layer of calcite lining part of the mold. The inner surface of this calcite film reveals beautifully developed costae, which are broad and are separated by equally wide interspaces. The costae of this surface, like those of the outer surface of the shell, do not extend

past the dorso-laterally situated shoulder. They are more regular and more strongly developed than those of the outer shell surface, whose costae are obscure and irregular and on the adult portion of the whorl appear to be more like growth lines than true costae.

Various interpretations of the above-mentioned characteristic of the shell are possible. According to Bøggild (1930, p. 299) the shells of the Bellerophontacea consist of a single layer of aragonite. If this statement is truly applicable to all bellerophontids then the shell of *T. vesculilineatus* must have had more well-devloped ornamentation on the inner surface than it did on the outer surface.

The most probable explanation is that two shell layers of completely different composition or structure were present. If the inner shell layer were originally aragonitic and the outer layer calcitic, it would be feasible that the inner aragonitic layer could be dissolved and that the outer calcitic layer resisted solution and was altered to secondary calcite at a later date, thus preserving its ornamentation and an impression of the inner layer. Although it would seem unusual that the inner shell layer should possess more prominent sculpture than the outer layer, there are some modern forms which may be cited as possible analogies. Both *Donax vittatus* (Bøggild, 1930, p. 287, pl. 6, fig. 6) and *Chiton* sp. *(op. cit.,* p. 297, pl. 8, figs. 4, 5) show evidence of a similar occurrence of "costae" on the lower shell layer, though on a much smaller scale than the case in question.

A third possible interpretation is that a thin inductura covered the entire shell. Many bellerophontid gastropods develop inductural deposits in the area of the umbilicus, and it might be possible that what has been referred to as the "outer shell layer" is an inductura covering the entire shell, thus masking the well-developed costae of the "lower layer." If this interpretation is correct it would still seem necessary to have the inductura of a different composition than the shell so that it could remain present in a few molds while the shell itself was selectively removed.

At present, the second of the above interpretations holds the greatest appeal for the author. It seems improbable that the inside of the shell should show a better development of ornamentation than the outside. It also seems improbable that an animal with such

a sharply angular dorsum as *Tropidodiscus* is apt to possess a mantle which envelopes the entire shell, especially since this would completely negate the purpose of an anal slit of any appreciable depth. It seems more probable that some of the Bellerophontacea had more than one shell layer and that one of these layers should be calcitic. Bøggild (1930, p. 299) mentioned one species of *Bellerophon* that questionably possessed a calcitic, albeit single-layered shell.

The trivial name of this species, *vesculilineatus,* is derived from the Latin *vesculus,* a diminutive form meaning "weak," and *lineatus,* meaning "of a line," referring to the weakly developed lines of ornamentation found on the final whorl of adult shells.

*Occurrence.* — Locality A - 45 specimens.

*Types.* — Holotype, No. 30667; figured paratypes, Nos. 30670, 40483; unfigured paratypes, Nos. 30668, 30674.

**Tropidodiscus compticarinatus** Linsley, n. sp. Pl. 25, fig. 5

*Description.* — Shell small, isostrophic, doubly phaneromphalous, with sharply angulated dorsum, and two to three whorls; whorls adpressed; whorl profile subhastate; selenizone situated on relatively high, angulated dorsal keel; whorl face sloping moderately laterad from the selenizone to a somewhat rounded, dorso-laterally situated shoulder, thence continuing with gentle convexity to the umbilical shoulder; whorl face reflexed at umbilical shoulder with little or no overhang on the umbilical slope; umbilici moderately wide; ornamentation consisting of closely spaced, well-defined transverse costae; costae and interspaces between costae equal in width; costae slightly more widely spaced and finer at dorso-lateral edge than at the umbilical shoulder; costae persisting all the way to the dorsal keel where they merge with the keel; parietal and outer lips unknown, probably with a deep V-shaped sinus and deep slit at periphery of outer lip. Shell structure unknown. The holotype measures about 8 mm in diameter and 3 mm in thickness.

*Remarks.* — This species is known from a single specimen from the Sibley quarry. The specimen is preserved as a replacement by calcite of the original shell material.

The species resembles in general form and ornamentation the type species of *Tropidodiscus, T. curvilineatus* (Conrad). It differs

from *T. curvilineatus* (Conrad) in having the diameter of the shell equal to one-fourth that of the type species and in having a higher dorsal keel. The ornamentation is more sharply defined than that of *T. curvilineatus*.

It differs from *T. vesculilineatus*, n. sp. in lacking a shoulder near the selenizone, and in having a smaller umbilical overhang, a higher selenizonal keel and much more distinctly marked costae, which are finer, more closely spaced, and extend from the umbilicus to the dorsal keel. There is no evidence of a second shell layer in this species; however, the mode of preservation is distinct from that of all other specimens of *Tropidodiscus* found in the Anderdon Limestone.

The trivial name of this species, *compticarinatus*, is derived from the Latin *comptus* meaning "ornamented" or "adorned" and *carinatus* meaning "keeled," referring to the beautiful ornamentation provided by the carinae.

*Occurrence.* — Locality B - one specimen.

*Types.* — Holotype No. 30671.

**Tropidodiscus cultricarinatus** Linsley, n. sp. Pl. 25, figs. 3a, b

*Description.* — Small, isostrophic, doubly phaneromphalous gastropods with a sharply angular dorsum and probably with a deep V-shaped sinus in the outer lip culminating at the dorsum in a slit that gives rise to a narrow selenizone; whorl profile hastate, acutely angulated at the dorsum and umbilical shoulder, sharply rounded and slightly overhanging on the umbilical slope; sutures sharply incised and moderately deep; umbilici moderately wide; nucleus unknown; parietal and outer lips unknown; outer lip presumably with a deep V-shaped sinus culminating at the crest of the dorsal angulation in a slit of unknown depth that gives rise to a narrow selenizone; judging from the ornamentation, the margins of the outer lip leave the umbilical sutures with a slight backward obliquity which gradually increases as they proceed to the angulated dorsum, resulting in a moderately strong forward convexity; selenizone poorly known, narrow; ornamentation consisting of numerous, sharp, almost foliaceous transverse costae with interspaces between the costae, equal in width to the costae; costae strong all the way to the dorsal keel where they merge with the

keel; shell unknown, but some evidence existing for a shell of two distinct layers. The holotype measures 7 mm in diameter and 2.2 mm in thickness.

*Remarks.* — This species is known from ten specimens collected from the quarry of Brunner, Mond Canada Ltd. It resembles the type species *Tropidodiscus curvilineatus* (Conrad) in general form and ornamentation and differs in having the diameter of the shell equal to one-fourth that of the type species and in possessing much more closely spaced costae which are sharper and more foliaceous. It can also be distinguished from *T. vesculilineatus,* n. sp. and *T. compticarinatus,* n. sp. by its numerous sharp costae. It can also be distinguished from *T. vesculilineatus* by the fact that the costae extend out to the angular periphery and the lack of a lateral shoulder. It can be distinguished from *T. compticarinatus* by having a lower peripheral keel.

Paratype 40487 (Pl. 25, fig. 3b) shows some evidence that also may have had a shell composed of two distinct layers, though the ornamentation is equally strong on either surface.

The three species of *Tropidodiscus* found in the Anderdon Limestone seem to be excellent stratigraphic markers as *T. vesculilineatus* is known only from the basal beds of the France Stone Company quarry (Locality A), *T. compticarinatus* only from the intermediate beds of the quarry of the Solvay Process Company at Sibley (Locality B), and *T. cultricarinatus* only from the upper beds from the quarry of Brunner, Mond Canada Ltd. (Locality C). It is impossible to tell at the present time whether these differences are due to spatial isolation or temporal evolution, but as the three localities are all within 50 miles of each other it would seem that spatial isolation would be ineffective. However, the fact that these species are found only in biostromal environments suggests the possibility that the inter-reef environments were a severe barrier to migration.

If further study, based on the finding of more material, should prove these three forms belong to an evolutionary series, it is probable the series extends from shells with broad, weak costae of *T. vesculilineatus,* to shells with medium costae of *T. compticarinatus,* and thence to shells with fine foliaceous costae of *T. cultricarinatus.*

The trivial name of this species, *cultricarinatus,* is derived from the Latin *culter* meaning "knife" and *carinatus* meaning "keeled." The name refers to the sharp foliaceous carinae, characteristic of this species.

*Occurrence.* — Locality C - 10 specimens.

*Types.* — Holotype, No. 40485; paratypes Nos. 40486, 40487.

Subfamily **BELLEROPHONTINAE** M'Coy, 1851

Genus **BELLEROPHON** Montfort, 1808

Subgenus **BELLEROPHON** Montfort, 1808

*Bellerophon* Montfort, 1808, p. 51.

*Type species.* — *Bellerophon vasulites* Montfort, 1808, by original designation.

**Bellerophon (B.) stummi** Linsley, n. sp. Pl. 25, figs. 2a-c

*Description.* — Small, subglobular, narrowly doubly planer-omphalous, planispiral gastropod with broad, moderately involute whorls and a narrow, moderately deep slit giving rise to a dorsal selenizone; whorl profile moderately arched dorsally, with slightly stronger arching on the sides and turning sharply into the narrow umbilici; aperture narrowly crescentic; inductura absent; outer portion of lip unknown, but lip flaring outward in umbilical region; outer lip apparently with shallow notch culminating dorsally in a moderately deep (?) sinus; selenizone slightly raised above the surface of the shell; ornamentation consisting of fine, closely spaced, transverse costae; shell apparently of moderate thickness, its structure unknown. Holotype measures 3.75 mm in diameter and 4.50 mm in width.

*Remarks.* — This species is known from five specimens collected from the France Stone Company quarry near Sylvania, Ohio. It resembles *Bellerophon (B.) vasulites* Montfort, 1808, in general form and ornamentation but differs from this type species in being less than one-fifth as large, in having a more narrowly crescentic aperture, in lacking an inductura, and in having finer ornamentation.

*Occurrence.* — Locality A - five specimens.

*Types.* — Holotype, No. 40512; figured paratype, No. 40511; unfigured paratypes, Nos. 40510 and 40456.

Suborder MACLURITINA Cox and Knight

Superfamily **EUOMPHALACEA** de Koninck, 1881

Family **EUOMPHALIDAE** de Koninck, 1881

Genus **OMPHALOCIRRUS** Ryckholt, 1860

*Omphalocirrus* Ryckholt, 1860, p. 187.

*Type species.* — *Euomphalus goldfussi* d'Archiac and Verneuil, 1842, by subsequent designation, Cossmann, 1915, p. 213.

**Ompalocirrus** sp. Pl. 39, figs. 1a, b

*Remarks.* — One specimen of an apparently undescribed species of *Omphalocirrus* was found in the Sibley quarry. Unfortunately only the mold of the base remains, but that is well preserved. It resembles the type species *Omphalocirrus goldfussi* (d'Archiac and Verneuil) in general form and ornamentation, including the spines of the "base" (assuming this genus to be dextral). It differs from the holotype of *O. goldfussi* in being less than one-third as wide, in having a more flattened base, and in being apparently less rotund. The spines appear to be set relatively farther out from the umbilicus than are those of the type species. The growth lines are conspicuous and unusually placed in bundles of four prominent ones, set off from the next bundle of four by a space of smooth shell which bears no apparent growth lines of any sort. Each growth line of a bundle is parallel to the other growth lines of the same bundle, but each bundle diverges from its neighbor as it proceeds from the umbilicus. The last formed growth line of each bundle swings obliquely backwards near the edge of the shell, truncating the other growth lines of the bundle to form a large troughlike spine. This pattern is maintained throughout most of the visible whorl but is lost on the latest formed part of the shell, possibly because of the failure to develop a spine at this point.

This undescribed species differs from *Omphalocirrus manitobensis* Whiteaves, 1802, in having a flat (?) base instead of a depressed base as found in *O. manitobensis*. The latter is also more than five or six times as wide as the form from the Anderdon Limestone and lacks the "bundling" of growth lines found in this form.

*Occurrence.* — Locality B - one specimen.

*Figured specimen.* — No. 40385.

Genus **STRAPAROLLUS** Montfort, 1810

*Straparollus* Montfort, 1810, p. 174.

*Type species.* — *Straparollus dionysii* Montfort, 1810, p. 174, by original designation.

Subgenus **SERPULOSPIRA** Cossmann, 1915

*Serpulospira* Cossmann, 1915, p. 144.

*Type species.* — *Serpulospira centrifuga* (F. A. Roemer), 1843, p. 31, by objective synonymy.

*Objective synonym.* — *Serpularia* F. A. Roemer, 1843, p. 31, a homonym of *Serpularia* Münster, 1840.

*Type species.* — *Serpularia centrifuga* (F. A. Roemer, 1843), by monotypy.

**Straparollus (Serpulospira) diversiformis** Linsley, n. sp. Pl. 35, figs. 3a-e, 4a-d, 5a-e, 6a-d

*Description.* — Small discoidal gastropods, with later whorls out of contact with the earlier whorls; whorls slender, subcircular to suboval in cross-section; sutures deep; nucleus seemingly normal but not well known, base widely phaneromphalus, shallow to moderately deep; apertural margins free on mature specimens with no notch, slit or sinus of any kind; ornamentation consisting of growth lines only; shell seemingly moderately thick to thin, its structure unknown; the holotype measures 8.3 mm across the upper whorls, the diameter of the free, final whorl about 2 mm; pleural angle 180 degrees.

*Remarks.* — This species differs from the type species *Serpulospira centrifuga* (F. A. Roemer) in being only one-fourth as large and discoidal at least in the early whorls, and in lacking any indication of a sinus in the outer lip. The species is common in all three localities visited by the author and exhibits a considerable amount of variation which for convenience of reference I have artificially divided into four types described below as morphotypes. *Straparollus (Serpulospira) diversiformis* morphotype "A" is characterized by being discoidal even in the mature whorls and having the whorls markedly out of contact after the second volution. *S. (S.) diversiformis* morphotype "B" is characterized by being discoidal with a slight depression of the adult whorl and by the possession of whorls

only slightly out of contact after the second volution. *S. (S.) diversiformis* morphotype "C" is characterized by being discoidal for two whorls (as in the other morphotypes) but with succeeding whorls becoming progressively more and more out of contact with the preceding whorls and the shell becoming increasingly helically spired, each successive whorl depressed farther out of the plane of the earlier whorls. The fourth type, *S. (S.) diversiformis* morphotype "D," is characterized by having the whorls becoming disengaged and greatly depressed, and deflected outwards at an early growth stage so that the planispiral stage found in the other three morphotypes is greatly restricted, the shell becoming helicoid. The whorls of this variation are greatly disengaged and give the appearance of being more slender than in the preceding morphotypes. This series of steps from being only slightly uncoiled in morphotype "A" to markedly uncoiled in morphotype "D" lends good support to the proposal by Knight and Bridges (1944) that *Serpulospira* Cossmann, 1915, is truly a subgenus of *Straparollus* Montfort, 1810. The young specimens would all be considered as *Serpulospira* morphotype "B," with its limited amount of uncoiling, and this form is close to that of *Straparollus*.

The various morphotypes found in the Anderdon Limestone apparently form a continuous series and the boundaries between the morphotypes are artificial. Any gaps in the pattern would probably be filled in by future collecting. These various morphotypes approximate the form of almost all described species of *Serpulospira* and are especially similar to a series described by De Koninck, as *Euomphalus serpula* de Koninck, 1883. The diagnostic features of *S. (S.) diversiformis*, n. sp. are the small size and the completely straight aperture, with no re-entrants.

The trivial name of this species, *diversiformis*, is from the Latin *diversus* meaning "different" and *forma* meaning "shape or figure" and refers to the many variations in the form of this species.

*Occurrence.* — Locality A - 36 specimens; Locality B - 30 specimens; Locality C - 10 specimens.

*Types.* — Holotype, No. 30680; figured paratypes, Nos. 30681, 30682, 30684, 40445, 40446, 40448, 40449, 40452, 40453, 40454; unfigured paratypes, Nos. 30683, 30685, 40447, 40450, 40451, 40455.

**Straparollus (Serpulospira) diversiformis** morphotype "A" Pl. 35, figs. 3a-e

*Remarks.* — This morphotype is characterized by its slightly elliptical whorl cross-section, by distinct uncoiling after the second whorl, and that all of the whorls lie in one plane.

*Occurrence.* — Locality A - four specimens; Locality B - five specimens; Locality C - one specimen.

*Types.* — Paratypes, Nos. 30682, 40445, 40446.

**Straparollus (Serpulospira) diversiformis** morphotype "B" Pl. 35, figs. 4a-d

*Remarks.* — This morphotype is characterized by being coiled almost completely in one plane, in having the whorls only slightly disengaged, and in having a subcircular whorl profile.

*Occurrence.* — Locality A — 19 specimens; Locality B — 10 specimens; Locality C — five specimens.

*Types.* — Holotype, No. 30680; figured paratypes, Nos. 40448, 40449; unfigured paratypes, Nos. 40447, 40450, 40451.

**Straparollus (Serpulospira) diversiformis** morphotype "C" Pl. 35, figs. 5a-e

*Remarks.* — This morphotype is characterized by having the first two whorls coiled in the same plane, then having the subsequent whorls disengaged with considerable downward depresssion and little or no outward deflection. The whorl cross-section is subelliptical, and the whorls appear bulky (as compared to morphotype "D") because of the limited amount of deflection.

*Occurrence.* — Locality A — 12 specimens; Locality B — eight specimens; Locality C — two specimens.

*Types.* — Figured paratypes, Nos. 30684, 40452; unfigured paratypes, Nos. 30683, 30685.

**Straparollus (Serpulospira) diversiformis** morphotype "D" Pl. 35, figs. 6a-d

*Remarks.* — This morphotype is characterized by the marked uncoiling which begins earlier than the uncoiling in the other three morphotypes. The early discoidal portion is sufficiently restricted to give the impression of a helically spired shell. Because of the rapidity of uncoiling, the whorls give the impression of being more slender than the preceding morphotypes. Morphotype "D" can be

differentiated from morphotype "C" in that the mature whorls of morphotype "D" are greatly depressed and greatly deflected from the earliest whorls, whereas the whorls of morphotype "C" are strongly depressed downwards but not noticeably deflected outwards.

*Occurrence.* — Locality A — one specimen; Locality B — seven specimens; Locality C — two specimens.

*Types.* — Figured paratypes, Nos. 30681, 40453, 40454; unfigured paratypes, No. 40455.

Subgenus **Euomphalus** J. Sowerby, 1814

*Euomphalus* J. Sowerby, 1814 (p. 97).

*Type species.* — *Euomphalus pentangulatus* J. Sowerby, 1814, p. 97, by subsequent designation, Meek and Worthen, 1866 A, p 158.

**Straparollus ? (Euomphalus)** sp. A Pl. 36, fig. 2

*Remarks.* — A single specimen was obtained from the Brunner, Mond Canada Company Limited quarry that apparently belongs to the subgenus *Euomphalus*. Only the steinkern and mold of the upper half of the shell remains; the character of the spire has been obliterated by fusion of the steinkern with the mold. The specimen is a discoidal shell with a depressed spire and a angular shoulder. The upper whorl face proceeds upward and outward from the upper suture and rounds off gently to a flat, subhorizontal area which occupies most of the upper whorl face. The upper and outer whorl face meet at a sharp shoulder and the two faces are close to perpendicular to each other. The outer whorl face is only poorly known, but at least the upper half is flat and subvertical. The aperture, spire, growth lines and base are unknown. The diagnostic features of this gastropod are the depressed spire, the flat whorl faces, and the sharp shoulder.

The specimen measures 51 mm in greatest width.

*Occurrence.* — Locality D — one specimen.

*Figured specimen.* — No. 40414.

**Straparollus ? (Euomphalus)** sp. B Pl. 36, fig. 3

*Remarks.* — One poorly preserved specimen was obtained from the Brunner, Mond Canada Ltd. quarry that I have hesitatingly

assigned to the subgenus *Euomphalus* J. Sowerby, 1814 (p. 97). It appears that all that remains of the specimen is an external (?) mold that is lined with a thick coating of crystalline calcite which obscures all ornamentation and obliterates any protuberances that may or may not have been present originally. This gastropod had a moderately large, discoidal shell with a depressed spire. The upper whorl face is slightly arched, leading to a strongly rounded shoulder. The outer whorl face is rounded. The base of the specimen is unknown. The sutures are broad and deeply incised and located about the middle of the previous outer whorl face. Aperture and lip are unknown. Most of the growth lines are obscured by a coating of crystalline calcite; a few coarse growth lines are visible through the layer of calcite. On the upper whorl face they are gently oblique backwards with a slight forward convexity. On the shoulder there is a broad shallow sinus which generates a rounded notch-keel on the shoulder but does not produce a selenizone. Below the notch-keel the growth lines continue straight down with a slight forward convexity which ultimately causes the growth lines to have a gentle backward obliquity. The specimen measures 44 mm in greatest width. It is possible that this specimen belongs to the same species as No. 40414, *Straparollus ? (Euomphalus)* sp. A with the outer shell layer broken away.

*Occurrence.* — Locality D — one specimen.

*Figured specimen.* — No. 40415.

**Straparollus ? (Euomphalus)** sp. C Pl. 36, figs. 1a, b

*Remarks.* — An interesting but poorly preserved specimen was found in the Brunner, Mond Canada Ltd. quarry. I have hesitatingly assigned this specimen to the subgenus *Euomphalus* J. Sowerby, 1814 (p. 97). Whether it belongs to this subgenus or to some entirely different genus, its structure strongly indicates that the specimen belongs to the family Euomphalidae de Koninck, 1881. The mold of the specimen has two distinct surfaces. The outer surface of the mold presumably represents the outer surface of the shell while the inner surface of the mold may represent the inner shell or less possibly the boundary between the inner and outer shell layers. At one place there is a void separating these two surfaces as though the thick shell of the gastropod had partially

dissolved at that point. If these two surfaces do represent the original boundaries of the shell, then this gastropod had a remarkably thick shell, as much as 10 millimeters thick at the shoulder.

The shell of this gastropod was moderately large and discoidal, and had a depressed spire, and a widely phaneromphalous base. The upper whorl face of the youthful whorls is gently arched and approximately parallel to the plane of coiling. In the ultimate whorl the upper whorl face is flat and slopes downward from the shoulder to the suture, so that the shoulder is noticeably higher than the spire. The upper whorl face joins the outer whorl face subangularly to form a prominent roundly angular shoulder. The outer whorl face is slightly rounded and in general perpendicular to the plane of coiling. The base is widely phaneromphalous. The basal whorl face is gently rounded and meets the outer whorl face at a roundly angular juncture. The sutures are broadly and deeply incised. Aperture and lip are unknown. The growth lines on the upper and outer whorl faces are completely obscured as the result of poor preservation. The growth lines of the base are well preserved and slope obliquely forward from the umbilical suture with a gentle forward concavity. The specimen measures 43 mm in greatest width.

*Occurrence.* — Locality D — one specimen.

*Figured specimen.* — No. 40416.

Suborder PLEUROTOMARIINA Cox and Knight

Superfamily **PLEUROTOMARIACEA** Swainson, 1840
Family **EOTOMARIIDAE** Wenz, 1938
Subfamily **EOTOMARIINAE** Wenz, 1938
Tribe **PTYCHOMPHALIDES** Wenz, 1938
Genus **MOURLONIA** de Koninck, 1883

*Mourlonia* de Koninck, 1883, p. 75.

*Type species.* — *Helix carinatus* J. Sowerby, 1812, p. 34 by original designation.

**Mourlonia** ? sp. Pl. 31, fig. 3

*Remarks.* — One specimen, consisting of two whorls, was found in the France Stone Company quarry and is regarded as belonging to the genus *Mourlonia* in its broadest interpretation. The specimen is a small, subtrochiform gastropod presumably with a shallow sinus in the outer lip culminating in a slit of unknown depth that gives

rise to a selenizone at the periphery. The upper whorl face is gently arched between the upper suture and the periphery. The selenizone is situated on a low keel at the peripheral angulation which is formed by the junction of the upper whorl face and the base. Immediately beneath the selenizone is a narrow concave area about equal in width to the selenizone. The base slopes inward sharply from the selenizone. The sutures are sharp, and are about a selenizone's width beneath the selenizone of the preceding whorl. The base is poorly known but gently arched just below the selenizone. The aperture is completely unknown, but judging from the growth lines the outer lip proceeds from the upper suture to the selenizone with moderate backward obliquity and slight forward convexity. Below the selenizone the growth lines show the outer lip to have had only a slight backward obliquity and slight forward concavity. The selenizone is slightly raised above the level of the neighboring surface of the shell and is bordered by two moderately strong revolving lirae. The lunulae are fine and weakly crescentic. No ornamentation is known other than fine growth lines and the selenizone. The specimen measures 5 mm in width and has a pleural angle of 77 degrees.

*Occurrence.* — Locality A — one specimen.

*Figured specimen.* — No. 40513.

### Genus **EHLERSINA** Linsley, n. genus

*Ehlersina,* n. genus.

*Type species.* — Here designated as *Ehlersina abditinoda,* n. sp.

*Description.* — Moderately large, trochiform, flat-bottomed nodose gastropods with a slit in the outer lip culminating in a narrow selenizone just above the nodose, angular periphery; whorl profile flat to gently arched, base flattened, minutely phaneromphalous in young individuals, crytomphalous (?) in adults; aperture strongly tapering, oval in outline; parietal, columellar and outer lips poorly known, apparently thin, not reflected; outer lip apparently with deep, narrow slit culminating in a selenizone just above the periphery; ornamentation consisting of two rows of nodes, one at the upper suture and one at the base, the basal row of nodes being covered by each succeeding whorl.

*Remarks.* — This genus is well represented in the Brunner, Mond Canada Ltd. quarry and is one of the most abundant of the large gastropods found there. The phylogeny of this genus is not completely known, but its closest relative appears to be *Euconospira* Ulrich and Schofield (1897) which occurs in Carboniferous and Permian strata. Consequently I am tentatively placing this genus in the family Eotomariidae and, hesitantly, in the subfamily Eotomariinae, tribe Ptychomphalides. It differs from *Euconospira* (and the closely related *Trechmannia* Longstaff, 1912) by not having an incised selenizone and by having coarse, nodose ornamentation.

The generic name *Ehlersina* is in honor of Dr. George Marion Ehlers, Professor at the Museum of Paleontology, University of Michigan.

**Ehlersina abditinoda** Linsley, n. gen. and n. sp. Pl. 31, figs. 2a-e; Pl. 32, figs. a-c

*Description.* — Moderately large, trochiform, flat-bottomed, nodose gastropods with a deep notch in the outer lip culminating in a slit which generates a narrow selenizone just above the nodose, angular periphery; whorl profile flat; periphery angular, base flat; sutures fairly distinct, not incised; base minutely phaneromphalous in young specimens, seemingly but not certainly becoming cryptomphalous in mature individuals; nucleus unknown; columellar, parietal, and outer lips poorly known, apparently thin, not reflected; columellar lip slightly thickened in adults, filling in the narrow umbicus; outer lip (judging from growth lines) probably sloping backward from upper suture with strong backward obliquity, which increases gradually from an angle of about 45 degrees to the vertical at the top of the whorl face to an angle of about 60 degrees near the selenizone, continuing below the periphery for a short distance (around the lower row of nodes) with forward obliquity which rapidly rounds into a gentle backward obliquity; thence continuing with a gentle sinuosity, with a shallow forward concavity just inside lower row of nodes which gradually changes to a gentle forward convexity to the shallow circumumbilical trough, then becoming more strongly concave forward on the circumumbilical ridge which acts as a callus; selenizone narrow bounded by two fine revolving lirae, occurring about its own width above the angular periphery; lunulae deeply cre-

scentic; depth of selenizone unknown, probably deep; ornamentation consisting of growth lines, the revolving lirae bordering the selenizone and two rows of nodes; the lower row of nodes occurring at the periphery and pointing downward, with moderate elongations extending onto the base; upper row of nodes located at top of whorl, covering the lower row of nodes of the preceding whorl up to the level of the selenizone of the preceding whorl; the position and number of nodes of the upper row determined by the number and position of the lower row of nodes of the preceding whorl, each node of the lower row covered by a node of the upper row of the succeeding whorl; nodes apparently absent on first two or three whorls; nodes first appearing on third whorl and by the fourth whorl the upper row appearing as a continuous scalloped flange breaking into discrete nodes on fifth and subsequent whorls; shell unknown, apparently thin, septae occurring in the earliest whorls, probably not occurring after the second or third. The holotype, No. 40417, consisting of seven or more whorls, measures 35 mm in height, 41 mm in width and has a pleural angle of 76 degrees.

*Remarks.* — This species is abundantly represented in the Brunner, Mond Canada Company Limited quarry; good specimens are rare and only two complete specimens (both poorly preserved) are available to me at present. The molds from the Brunner, Mond Canada Company Limited quarry are generally lined with calcite crystals, and the molds of the nodes are usually completely filled with crystals. Consequently it is difficult to remove the crystal completely without altering the original shape of the node. Fortunately one good specimen was found with little or no calcite encrusting the mold, and other specimens are sufficiently devoid of calcite crystals to allow a fairly accurate interpretation of the nodal structure. No single specimen shows all of the characteristics of this species, and the description above is based upon 12 incomplete specimens each of which shows one or more structures well.

The trivial name of this species *abditinoda* is derived from the Latin *abditus* meaning "hidden or concealed" and *nodus* meaning "knot or swelling" and alludes to the fact that the lower row of nodes is covered by each succeeding whorl.

*Occurrence.* — Locality D — 50 specimens.

*Types.* — Holotype, No. 40417; figured paratypes, Nos. 40418, 40419, 40421, 40423, 40426, 40429; unfigured paratype, No. 40420.

**Ehlersina paucinodosa** Linsley, n. sp. Pl. 32, figs. 2a-d

*Description.* — Moderately large, trochiform, flat-bottomed, nodose gastropods with a deep notch in the outer lip culminating in a slit which generates a narrow selenizone just above the nodose, angular periphery; whorl profile gently arched; periphery angular, base flat; sutures fairly distinct, not incised; base apparently anomphalous, possibly cryptomphalous in mature individuals; nucleus unknown; columellar, parietal and outer lips unknown; outer lip probably sloping backward from upper suture with strong backward obliquity, which increases gradually from an angle of about 45 degrees to the vertical at the top of the whorl face, to an angle of about 60 degrees near the selenizone; outer lip of the base with forward obliquity around the lower row of nodes which rapidly rounds into a gentle backward obliquity; shape of lip unknown from this point on, presumably similar to those of the type species; selenizone narrow, bounded by two fine revolving lirae; position of selenizone about its own width above the periphery; lunulae unknown; depth of selenizone unknown; ornamentation consisting of growth lines, selenizone, and two rows of nodes; the lower row of nodes poorly known, occurring at the periphery and pointing downward; upper row of nodes located at the top of the whorl, adpressed onto the lower row of nodes of the preceding whorl up to the level of the selenizone of the preceding whorl; nodes relatively few per whorl, their number and position being determined by the number and position of the lower row of nodes of the preceding whorl, each node of the lower row covered by a node of the upper row of the succeeding whorl; nodes apparently absent on first two or three whorls; nodes first appearing on third whorl and by fourth whorl the upper row appear as a continuous scalloped flange, breaking into discrete nodes on fifth and subsequent whorls; shell unknown, apparently thin. The holotype, No. 40424, consisting of at least five whorls, is 26 mm in height and 29 mm in greatest width, and has a pleural angle of 65 degrees.

*Remarks.* — This species is known from 10 specimens from unit 15 of the Brunner, Mond Canada Ltd. quarry. Only one specimen

(paratype, No. 40425) shows the base. It is the most complete specimen of the genus as well as this species, but unfortunately it is an internal mold which lacks all of the external features, except the sparsely distributed nodes. This species differs from the type species *E. abditinoda,* n. sp. in that the nodes are fewer and more widely spaced, and that the whorl profile is gently arched between the sutures.

The trivial name of this species, *paucinodosa,* is derived from the Latin *paucus* meaning "few" and *nodus* meaning "knot or swelling" and refers to the relative paucity of nodes in this species.

*Occurrence.* — Locality D - 10 specimens.

*Types.* — Holotype, No. 40424; paratypes, Nos. 40422, 40425, 40427.

**Ehlersina** ? sp. Pl. 30, fig. 4

*Remarks.* — One large, incomplete, poorly preserved specimen was collected from the Brunner, Mond Canada Ltd. quarry that bears some resemblance to *Ehlersina abditinoda,* n. sp. but most probably belongs to a different genus. It is a large, trochiform nodose gastropod with a concave whorl profile. The specimen possesses at least seven whorls, each whorl with an increasingly larger pleural angle to create a concave whorl profile. There appears to be only one basal row of nodes and each node continues up the whorl face to form a rounded, transverse rib, which decreases in intensity toward the upper suture. The growth lines are poorly known but seem to have a strong backward obliquity and gentle forward concavity. No other structures can be determined from the specimen.

*Occurrence.* — Locality D - one specimen.

*Figured specimen.* — No. 40428.

Family **LOPHOSPIRIDAE** Wenz, 1938

Subfamily **LOPHOSPIRINAE** Wenz, 1938

Genus **LOXOPLOCUS** Fischer, 1885

*Loxoplocus* Fischer, 1885, p. 847.

*Type species.* — *Murchisonia tropidophora* Whiteaves, 1884, p. 29, by monotypy.

### Subgenus **DONALDIELLA** Cossmann, 1903

*Donaldiella* Cossmann, 1903, p. 68.

*Type species.* — *Goniospira filosa* Donald, 1902, p. 329, by objective synonymy.

**Loxoplocus (Donaldiella)** ? sp. Pl. 33, fig. 4

*Remarks.* — One specimen was collected from the France Stone Company quarry which has been tentatively assigned to the subgenus *Loxoplocus (Donaldiella)* Cossmann, 1903. The specimen is small, only 8 mm in height and 2 mm in diameter. It is a high-spired shell with many angular whorls and apparently has a shallow sinus which may or may not culminate in a selenizone generating slit. If a true selenizone is present then this specimen must be considered as a species of the Murchisoniacea. The upper whorl face proceeds flatly downward from the upper suture to the subangular periphery and continues flatly inward below the periphery to the lower suture. The sutures are deep and angular, and are inclined at an angle of 62 degrees from the axis of the shell. The base is unknown. The inner and outer lips are unknown, but the outer lip, judging from poorly preserved growth lines, left the upper suture with only a slight backward obliquity and apparently a slight forward concavity, then continues below the selenizone with a slight forward obliquity.

According to Wenz (1938) and Knight, *et al,* (1960), this subgenus has previously been known only from the Ordovician and Silurian with only one questionable reference from the Silurian of North America (Wenz, 1938, p. 163), so the identification of this specimen as *Loxoplocus (Donaldiella)* must be regarded as highly tentative.

*Occurrence.* — Locality A - one specimen.

*Figured specimen.* — No. 40342.

### Family **RAPHISTOMATIDAE** Koken, 1896

### Subfamily **RAPHISTOMATINAE** Koken, 1896

### **ZALOZONE** Linsley, n. genus

*Type species.* — Here designated as *Zalozone lacunata,* n. sp.

*Description.* — Trochiform gastropods with a low spire and

deep, rounded base; a broad, shallow slit culminating at the base of a deep, V-shaped sinus and generating a broad, undulating selenizone at the periphery of the whorl; upper whorl face flattened and sloping gradually outward and downward away from the upper suture; the periphery of the upper whorl face undulating in rhythm with the selenizone; the outer whorl face gently rounded and confluent with the lower whorl face; base anomphalous; parietal lip with moderately thickened inductura; outer lip thin; ornamentation consisting of fine colabral lines and the fluted selenizone.

*Remarks.* — This genus is known from only five specimens obtained from the Brunner, Mond Canada Ltd. quarry in Ontario, Canada. Its diagnostic features are the deep base and the broad undulating selenizone whose undulations involve the upper whorl face. It can readily be distinguished from its close relatives *Buechelia, Raphistoma,* and *Arizonella* in that it possesses the unusual selenizone. It presents an interesting example of convergence with the contemporary genus *Luciella* de Koninck which also possesses an undulating upper whorl face remarkably like that of *Zalozone.* In fact until a specimen of *Zalozone* was discovered which showed the base, this new species was thought to belong to the genus *Luciella.* However, the deep base and general shape of the aperture clearly shows that *Zalozone* belongs to the Raphistomatidae and not the Luciellidae.

The similarity of this new genus to the Upper Devonian genus *Arastra* Stoyanow must also be noted. Again the undulating selenizone of *Zalozone* permits it to be easily distinguished from *Arastra.* However, the similarities between these two genera are sufficiently great to warrant removing it from the Liospirinae (see Knight, *et al.,* 1960( p. 1201) and placing it in the subfamily Raphistomatinae. Though the similarities between *Arastra* and *Zalozone* would certainly suggest the possibility of a fairly close kinship, it may again be a matter of convergence. A close examination of the types will have to determine whether the selenizone emplacement warrants their being in the same subfamily or not.

The generic name *Zalozone* is derived from the Greek *zalos* meaning wavey, and *zone* meaning "belt" or "girdle" referring to the undulating selenizone.

**Zalozone lacunata** Linsley, n. gen., n. sp. Pl. 26, figs. 2a-c; Pl. 27, figs. 2a-h

*Description.* — Moderately large, trochiform gastropods with slightly concave spire profile and a slit or notch in the outer lip giving rise to a unique undulating selenizone just beneath an unusual fluted, frilled periphery; each upper whorl face flat or slightly concave between sutures; selenizone and part of outer whorl face exposed below the frill and the suture at the succeeding whorl creating a sharp shoulder, which may be high in the adult whorls; each successive whorl with a slightly larger pleural angle causing the spire to have a gently concave profile; sutures sharp, deeply incised, falling well below the selenizone on the outer whorl face; the distance between the suture and the selenizone becoming increasingly greater with each successive whorl; nucleus unknown; outer whorl face falling vertically downward from the selenizone, then rounding onto the base; base gently rounded, deep, anomphalous, with a revolving groove occurring about two-thirds the way down the base from the lower border at the selenizone; columellar lip quite long, arcuate, slightly thickened, parietal lip poorly known, probably with a thin parietal inductura; outer lip poorly known, presumably thin with a notch or slit generating an undulating selenizone just beneath the fluted frill; the margin of the lip, based on a study of growth lines, passing outward from the upper suture to the frill with a strong backward obliquity and slight forward convexity, proceeding below the selenizone with slight forward obliquity, slowly turning to a gentle backward obliquity creating a gentle forward convexity; growth lines strengthened to form faint collabral ornamentation at least on the upper whorl face; selenizone poorly known, broad and flat, undulating in pace with the frill and in contact with the trough of the frill; the crest of the frill apparently higher than the crest of the selenizone thus separating itself from the selenizone at this point; lunulae poorly known, apparently straight, not concave or convex, seemingly perpendicular to the borders of the selenizone; ornamentation consisting of a wide but thin, fluted frill overhanging the selenizone at the shoulder, and fine collabral ornamentation on the upper whorl face, sloping from the upper suture with a strong backward obliquity and gentle forward con-

vexity; selenizone and frill not undulating in earlier whorls; undulations appearing gradually as ephebic whorls are reached; ornamentation of the base consisting of growth lines and shallow revolving groove. Holotype, No. 40388 consisting of 6 (+?) whorls, measuring 42 mm in width with a pleural angle of 118 degrees. Pleural angle of earlier whorls about 100 degrees.

*Remarks.*—*Zalozone lacunata,* n. sp. differs from *Luciella eliana* de Koninck by being anomphalous, in having an undulating selenizone exposed on each whorl face, and in having ornamentation that slants obliquely backward, rather than the reticulate pattern characteristic of that species. It differs from *Arastra* Stoyanow, 1948 in having a lower, more concave spire, a more acute periphery, a smoother upper whorl surface and a more finely featured frill at the periphery, and in possessing the unique undulating selenizone.

The exact nature and significance of the selenizone is not completely understood at this time because of the lack of good specimens. Indeed the presence and position of a selenizone is still open to some debate. However, careful examination of the thickened, undulating area underlying the frill has convinced the author that it truly represents a selenizone. I have been led to this interpretation because this broad area is bordered by two prominent, revolving threads and is distinct from the thin frill which overlies this area. Dr. Roger Batten examined the specimens and concurs with the author's opinions (personal communication). The selenizone does not underlie the undulating border as might be expected in comparing these specimens to true members of the genus *Luciella.* On the holotype, No. 40388, growth lines proceed right up to the thickened, undulating border with no indication of a selenizone or sinus of any sort.

A few growth lines apparently cross this undulating border at widely separated intervals; they are ill-defined, but appear to be straight and perpendicular to the borders of the selenizone. The fact that these growth lines are not concave gives some cause to doubt the interpretation that this undulating border is a selenizone; however, straight lunulae are present in the selenizone of other genera.

This species is known from four specimens from the Brunner,

Mond Canada Ltd. quarry. The holotype, the largest specimen, has most of the base missing. One paratype, No. 40390, shows the base and the outline of the aperture, though the spire of this specimen is poorly preserved. This paratype shows no growth lines but does show one revolving groove on the base. Knowledge of the base of this species is limited to information available from this one specimen.

Text-figures 3-5 show a reconstruction of the author's interpretation of this species based on careful study of all available specimens.

The trivial name of this species *lacunata* is derived from the Latin meaning "fluted" and refers to the fluted frill at the periphery.

*Occurrence.* — Locality D - four specimens.

*Types.* — Holotype, No. 40388; paratypes, Nos. 40389, 40390, 40392.

**Zalozone** sp. cf. **Z. lacunata** Linsley, n. sp. Pl. 26, fig. 3; Pl. 27, fig. 2; Pl. 28, fig. 2

*Remarks.* — One specimen was collected from the Brunner, Mond Canada, Ltd. quarry which greatly resembles *Z. lacunata*, n. sp. and is undoubtedly congeneric with it. It differs from *Z. lacunata* by being lower spired so that the upper suture falls just below the selenizone instead of part way down the whorl face. Thus the concavity at the spire profile is greater, and the steps in the spire profile are less marked. The sutures are not incised in this specimen as they are in *Z. lacunata*. The growth lines on the upper whorl face do not show as great a degree of backward obliquity as those of the type species. It seems probable that this is a new species, but not enough information is presently available to describe it with any certainty.

*Occurrence.* — Locality D - one specimen.

*Figured specimen.* — No. 40391.

### Genus **TYLOZONE** Linsley, n. gen.

*Type species.* — Here designated as *Tylozone commensurata* Linsley, n. sp.

*Description.* — Turbiniform gastropods with turreted spire, a short siphonal canal at base of aperture and a broad, fairly shallow,

V-shaped sinus in the outer lip culminating in a short slit at the crest of the shoulder and generating a fairly broad, concave selenizone, periodically raised into nodes; spire profile gently concave, turreted; upper whorl face rugosely adpressed to outer face of previous whorl, flattened to concave between upper suture and periphery; outer whorl face flattened between selenizone and revolving carina; lower whorl face flattened to a coarse circumumbilical ridge; base narrowly phaneromphalous; parietal lip forming moderately thick parietal inductura, columellar lip reflected, ending at its base in a coarse, thickened short siphonal (?) notch, which builds the circumumbilical ridge; outer lip thin with sinus occurring at upper shoulder; ornamentation consisting of coarsely nodose selenizone, coarse, foliaceous growth lines, and in some shells rows of nodes on the base.

*Remarks.* — This genus is known from two new species collected from the Brunner, Mond Canada Ltd. quarry in Ontario. Its diagnostic structures are the turreted spire, the nodose selenizone on the shoulder, the short siphonal canal at the base of the aperture, and the coarse, foliaceous growth lines.

The taxonomic position of this genus is debatable. However, in the author's opinion, the genus fits best in the superfamily Pleurotomariacea, family Raphistomatidae, subfamily Raphistomatinae but apparently on an evolutionary stem other than the progression marked by *Scalites, Raphistoma, Buechelia.*

The generic name *Tylozone* is derived from the Greek *tylos* meaning "knot" and *zone* meaning "belt" or "girdle" referring to the nodose selenizone.

**Tylozone commensurata** Linsley, n. sp. Pl. 25, figs. 1a-f; Pl. 26, figs. 1a-d

*Description.* — Moderately large, narrowly phaneromphalous, turbiniform gastropods with a moderately low turreted spire, a short siphonal (?) notch in the lower part of the aperture and a broad, moderately deep V-shaped sinus in the outer lip culminating in a short slit at the shoulder and generating a fairly broad, concave selenizone, periodically raised into nodes; spire short, spire profile gently concave; total height of shell approximately equal to total width; upper whorl face rugose in adults, adpressed against

side of previous whorl, flat to slightly concave; nodose selenizone occurring at the outer edge of the whorl face, forming an angular shoulder; outer whorl face flattened, subvertical, sloping inward slightly from selenizone to a row of nodes forming a slight angulation at the boundary of the outer whorl face with the base; profile of base gently concave to a more or less indistinct third row of nodes midway between outer whorl face and umbilicus, then sharply concave forming a narrow but distinct circumumbilical groove; inside umbilical groove a rough, highly thickened, short siphonal notch forming coarse circumumbilical ridge; base narrowly phaneromphalous; sutures irregular, adpressed, moderately incised, falling at, or slightly below, the base of the nodose selenizone, so that of the three rows of nodes, only the nodose selenizone being exposed on the whorls of the spire; parietal inductura moderately thick; columellar lip reflexed, strongly thickened at the base forming a short siphonal notch which generates a coarse circumumbilical ridge; outer lip thick, leaving the upper suture with a moderate backward obliquity which quickly turns to a strong backward obliquity, resulting in a strong forward convexity; just above the periphery the outer lip turning backward with extreme obliquity forming moderately deep V-shaped sinus culminating at its base in a broad, selenizone-generating notch; outer lip continuing below selenizone subvertically, with a slight forward convexity, thence onto the base with a moderate backward obliquity; selenizone broad, slightly concave; a flat, spiral band in youthful stages, slightly undulating by the end of second whorl, with distinct nodes by end of third whorl; nodes on selenizone large on adult body whorl, or in some shells absent; selenizone apparently expanding at the position of the nodes, narrower in between giving the impression of tremata; lunulae deeply concave; ornamentation consisting of strongly nodose selenizone, a weaker row of nodes at the junction of the outer whorl face and the base, and, on adult specimens, a third, faint row of nodes occurring midway between the outer whorl face and the umbilicus; other ornamentation consisting of short, rough, thickened siphonal (?) notch and coarse, foliaceous growth-lines; shell probably moderately thick, structure unknown; nucleus poorly known, seemingly simple, smooth and dextral. The

holotype, consisting of eight whorls, measures 45.0 mm in height, 45.5 mm in width and has a pleural angle of 113 degrees. Paratype, No. 40438, consisting of six whorls, measures 18 mm in height, 16.25 mm in width with a pleural angle of 70 degrees. Paratype, No. 40436, consisting of seven whorls, measures 33 mm in height, 31 mm in width with a pleural angle of 96 degrees.

*Remarks.* — This species is represented by 43 specimens, many of which are relatively well preserved, collected from the Brunner, Mond Canada Ltd. quarry near Amherstburg, Ontario. A number of these specimens show complete apertures — a distinct rarity among the Anderdon gastropods. Also a number of the specimens represent immature stages, so that something of the ontogenetic stages can be learned from them. (In most of the large gastropods from the Anderdon Limestone, the spires are missing and smaller shells must be found that are likely to show the character of the earlier whorls.) The holotype in particular, is well preserved and is complete except for the base of the circumumbilical ridge.

The selenizone of this species is of special interest for the problems it creates. On the later ephebic whorls the selenizone is periodically swollen and raised to form regular, well-developed nodes. However, on the body whorl of the holotype, No. 40361, nodes are absent for one-half of a volution but present just before the aperture is reached. On paratype, No. 40439, the nodes are well developed on the spire but absent on the body whorl. Where the nodes are absent the selenizone is a band which alternately undergoes expansion and contraction, thus resembling tremata that are not completely closed off. The most probable interpretation of the seemingly unusual behavior of the selenizone is that the nodes were removed by physical or chemical wear and that the expanded "pseudo tremata" represent the base of a node. This conclusion is substantiated by the apparent absence of lunulae in the expanded portion of the selenizone and their presence in the constricted areas. If this absence of nodes on the body whorl is a natural phenomenon it must be proven by better material than is now available.

The trivial name, *commensurata,* is derived from the Latin meaning equidimensional, referring to the equality of the height and width of this species.

*Occurrence.* — Locality D - 43 specimens.

*Types.* — Holotype, No. 40361; figured paratypes, Nos. 40434, 40436, 40438, 40439, 40440; unfigured paratypes, Nos. 40435, 40437, 40441, 40442.

**Tylozone turricula** Linsley, n. sp. Pl. 26, figs. 5a-c

*Description.* — Moderately large, narrowly phaneromphalous, turbiniform gastropods with a high turreted spire, a short siphonal notch in the lower part of the aperture and a broad, moderately deep, V-shaped sinus in the outer lip culminating in a short slit at the shoulder, and generating a fairly broad, concave selenizone, periodically raised into nodes; spire moderately high, spire profile strongly concave; total height of shell substantially greater than total width; upper whorl face flat to slightly concave; nodose selenizone occurring at the outer edge of the whorl face, forming an angular shoulder; outer whorl face flattened, subvertical, sloping inward slightly to lower portion of outer whorl face; base joins outer whorl face with more or less abrupt rounding; base gently rounded to circumumbilical groove, inside of which occurs a rough, highly thickened, short, siphonal (?) canal forming circumumbilical ridge; base narrowly phaneromphalous; sutures irregular, adpressed, moderately incised, in most specimens situated about halfway down the outer whorl face; parietal inductura poorly known, apparently thin; columellar lip reflexed, strongly thickened at the base forming a short siphonal (?) notch, which generates a coarse circumumbilical ridge; outer lip thin, leaving the upper suture with a strong backward obliquity and moderate forward convexity, forming a sinus which culminates at the shoulder in a selenizone-generating notch; outer lip below selenizone poorly known, presumably continuing below selenizone subvertically, with slight forward convexity, thence onto the base with a moderate backward obliquity; selenizone broad, slightly concave; a flat spiral band in youthful stages, slightly undulating by end of third whorl, with distinct nodes by end of fourth or fifth whorl; nodes pronounced on sixth and seventh whorls, possibly reduced on adult (eighth) whorl; ornamentation consisting only of strongly nodose selenizone, moderately coarse growth lines and the thick siphonal (?) canal; shell probably moderately thick, structure unknown; nucleus unknown. The holotype, consisting of

eight (?) whorls, is 51 mm in height and 41 mm in width, and has a pleural angle of 92 degrees. Paratype consisting of eight (?) whorls is 59 mm in height and 45 mm in width with a pleural angle of 70 degrees.

*Remarks.* — This species is known from five specimens, all of which are poorly preserved. It can be distinguished from *Tylozone commensurata,* n. sp. by being at least 20 per cent taller than it is wide, whereas *T. commensurata* is no more than eight per cent taller than it is wide. *T. turricula* lacks the rows of nodes found on the base of the body whorl of *T. commensurata. T. turricula* is higher spired with a more acute pleural angle and has the upper suture located farther down on the outer whorl face of the previous whorl. In the specimens available, there is no evidence that these variations form a continuous series between the two species; however, the study of more and better specimens may show that these shells are only variants of a single species.

The trivial name *turricula* is derived from the Latin meaning "turret" and refers to the high turreted appearance of the species.

*Occurrence.* — Locality D - five specimens.

*Types.* — Holotype, No. 40443; paratype, No. 40444.

**Tylozone** sp. cf. **T. turricula** Linsley, n. sp. Pl. 26, fig. 4

*Remarks.* — One specimen was found that consists of a well-preserved aperture and part of the base of a gastropod which appears to be a specimen of *Tylozone,* n. gen. It certainly is not *T. commensurata,* n. sp.; it may possibly be an example of *T. turricula,* n. sp. It is discouraging to find a gastropodal aperture in a fauna where apertures are so rare and not be able to definitely assign it to a known species. The lip of this specimen has been broken for about one-eighth of a whorl; as the result of this damage, the structure of the lip is not well defined. The aperture has a marked quadrangular shape. The parietal inductura is thick, the columellar lip seemingly ended in a short siphonal (?) canal, as in typical specimens of *Tylozone;* the outer lip is thin, with a sharp periphery, presumably at the location of the selenizone. The upper whorl face is flat to gently concave, while the outer lip is flattened, and the base strongly rounded. The base is narrowly phaneromphalous. In the author's opinion, it seems that the specimen is a member of

the genus *Tylozone;* it belongs either to *T. turricula* or to an undescribed species.

*Occurrence.* — Locality D - one specimen.

*Figured specimen.* — No. 40441.

Family **PORTLOCKIELLIDAE** Batten, 1956

**NODONEMA** Linsley, n. genus

*Type species.* — Here designated as *Nodonema granulatum,* n. sp.

*Description.* — Turbinoform gastropods with flat to arched whorl profile, bearing a selenizone just below periphery of the whorl; sutures sharp, moderately deep; base rounded, phaneromphalous; columellar lip poorly known, probably slightly thickened; outer lip thin; ornamentation consisting of strong revolving nodose lirae which in some adult shells may be absent on the body whorl; nucleus smooth, simple, dextral.

*Remarks.* — This genus is typified by the revolving nodose lirae (whence the name) and the low position of the selenizone. According to J. Brooks Knight (personal communication to G. M. Ehlers) this genus is intermediate between *Rhineoderma* de Koninck, 1883, and *Portlockiella* Knight, 1945. *Nodonema* may be distinguished from *Rhineoderma* by its narrower umbilicus, the lower position of the selenizone, and by the lack of the nodular ornamentation within the selenizone. It may be distinguished from *Portlockiella* in having a revolving ornamentation that is more nodular and transverse growth lines that are less marked. The selenizone is lower in *Nodonema* than in *Portlockiella* and the inner lip of *Nodonema* shows no evidence of thickening and of filling the umbilicus as in *Portlockiella.*

J. B. Knight suggested the above mentioned generic relationships in 1950 and more recently Roger L. Batten (1956) introduced the family Portlockiellidae and placed in it the genera *Portlockiella* Knight, 1945, *Agniesella* Cossmann, 1909, *Shansiella* Yin, 1932, and *Tapinotomaria* Batten, 1956. This family is differentiated from other families primarily by the position of the selenizone, which occurs low on the whorl, but also by the globular (to turreted) whorls and coarse, revolving ornamentation. The new genus *Nodonema* has the structural characteristics of members of this fam-

ily and may be distinguished from the above mentioned genera by having a selenizone which is located lower on the whorl.

*Rhineoderma,* on the other hand, is now considered by Knight, *et al.* (1960) to belong to the family Sinuopeidae Wenz, 1938 and thus may be considered as being far removed from the Portlockiellidae.

*Nodonema* differs from the other genera of the family Portlockiellidae in having the selenizone located lower on the whorl and a more well-developed umbilicus. Although poorly known, the columellar lip is apparently not as greatly thickened (see Pl. 29, fig. 19) as those lips of the other genera in this family. Another unique feature is that the only known species of *Nodonema (N. granulatum,* n. sp.) is variable, whereas the other species of the family Portlockiellidae are stable.

**Nodonema granulatum** Linsley, n. sp. Pl. 28, figs. 3a-m

*Rhineoderma* sp. Ehlers, Stumm, and Kesling, 1951, pl.3, figs. 25, 27.

*Description.* — Small, turbiniform gastropods with nodular revolving ornamentation and a shallow sinus culminating on the periphery in a notch that gives rise to a selenizone; whorl profile varying from well rounded to flat between sutures, rounded at the periphery on the final whorl; sutures sharp, moderately deep; base rounded, moderately phaneromphalous; columellar lip poorly known, but apparently slightly thickened and arcurate; parietal inductura unknown; outer lip unknown, but probably thin, with a moderately wide, angular sinus culminating at the periphery in a shallow notch, which gives rise to a wide selenizone bounded by strong, sharp, sometimes nodose lirae; the margin of the outer lip on the upper surface sweeping obliquely backward from the upper suture to the selenizone with slight forward convexity; below selenizone sweeping obliquely forward with a gentle forward convexity; the selenizone, which lies just below the periphery, is bounded by two revolving lirae, with a third intermediate lira midway between the bounding lirae; lirae may or may not be nodose; lunulae arcuate; ornamentation usually consisting of strong revolving nodose lirae, missing in some body whorls, in which case, ornamentation consisting of only selenizone and faint growth lines; revolving lirae occasionally solid, not broken into nodes in immature specimens; revolving

lirae about equal in size, and evenly spaced, with newly originated lirae arising by intercalation between stronger lirae at irregular intervals; up to 20 lirae occurring on final (fourth) whorl; growth lines faint, apparently not always related to the nodes; nucleus unknown. The holotype is 6 mm in height and 4.25 mm in width, with a pleural angle of about 58 degrees.

*Remarks.* — This species is the most abundantly represented form found in the Anderdon Limestone fauna. Its distinguishing characteristics are its strongly nodose lirae and small size. The whorl profile and the general form of the shell is variable. The pleural angle ranges from 47° to 80°. Although some of this range is due to the age of the shells (the older ones having a smaller pleural angle than the young), there is still a wide range. The whorl profile varies from well rounded from suture to suture with no shoulder or angulation at the selenizone, to only slightly arcuate from the upper suture to a subangular periphery and thence sloping backward sharply to a flattened base. There are all gradations between these two extremes, indicating a case of variation within the species. In a few shells, the body whorl is smooth and lacks nodes, although there are nodes present on the earlier whorls. Only on such body whorls can growth lines be determined. As none of the specimens have the outer lip preserved, it is only through the use of the growth lines that the character of the outer lip may be deduced. The absence of nodes on the body whorl of some shells seems to be primarily a matter of individual variation of this species and is not due to erosion of the shell material either before or after burial; obviously the fine growth lines on such specimens would not survive any wear that is strong enough to remove the nodes.

*Occurrence.* — Locality A — 74 specimens; locality B — 424 specimens; locality C — 5 specimens.

*Types.* — Holotype, No. 40369; figured paratypes, Nos. 40370, 40371, 40372, 40373, 40374, 40375, 40376, 40377, 40379, 40380; unfigured paratype, No. 40378.

Family **GOSSELETINIDAE** Wenz, 1938
Subfamily **COELOZONINAE** Knight, 1956
Tribe **COELOZONIDES** Knight, 1956
Genus **COELOZONE** Perner, 1907

*Coelozone* Perner, 1907 (p. 44).

*Type species.* — *Pleurotomaria (Coelozone) verna* Perner, 1907 (p. 45) by original designation.

**Coelozone fasciata** Linsley, n. sp. Pl. 29, figs. 4a, b

*Description.* — Small, rotelliform gastropods with a low spire and probably a sinus in the outer lip that culminates at the periphery in a slit or notch giving rise to a selenizone; whorl profile strongly arched between suture and below selenizone resulting in subcircular whorl cross section; nucleus not well known, seemingly normal and dextral; suture sharp, relatively deep, situated adjacent to the middle of or just below the selenizone of the previous whorl; base rounded, probably narrowly phaneromphalous; cellular lip unknown, parietal lip unknown; outer lip unknown, probably culminating at the periphery in a notch or slit of unknown depth which gives rise to a selenizone; outer lip presumably sloping backward obliquely with a moderate forward convexity to the selenizone and continues below the selenizone onto the base with a gentle forward convexity and obliquity; selenizone concave, depressed between two fine bordering lirae, the lunulae poorly known; shell unknown, presumably thin; ornamentation consisting only of fine tranverse growth lines and selenizone. The holotype is 1.75 mm in height and 3.5 mm in width with a pleural angle of 128 degrees.

*Remarks.* — This species differs from the type species *Coelozone verna* Perner in being about one-tenth as large, in having a larger pleural angle, stronger collabral ornamentation and a narrower selenizone bounded by threads which are more distinct than those found on *C. verna.* Though the base of this new species is not well known, it would appear to be more narrowly phaneromphalous than that of the type species. The species is known from a single specimen collected from the Brunner, Mond Canada Company Limited quarry near Amherstburg, Ontario.

The trivial name of this species, *fasciata,* is the Latin word meaning "envelope with bands" referring to the selenizone occurring at the perimeter of the shell.

*Occurrence.* — Locality D — one specimen.

*Type.* — Holotype, No. 40386.

Genus **EURYZONE** Koken, 1896

*Euryzone* Koken, 1896, p. 506.

*Type species.* — *Helcites delphinuloides* Schlothiem, 1820, p. 102, by subsequent designation of Perner, 1907, p. 37.

**Euryzone petilitornata** Linsley, n. sp. Pl. 28, figs. 1a-g; Pl. 29, figs. 3a-h

*Description.* — Small, discoidal to low-spired, turbiniform gastropods with a flattened, subhorizontal upper whorl-face, and probably with a sinus in the outer lip culminating in a broad, probably shallow notch which generates a broad selenizone at the juncture of the upper and outer whorl faces; upper whorl face flattened, slightly depressed from selenizone to suture; selenizone broad, flat, located at juncture of upper and outer whorl faces, sloping downward and outward approximately at a 20 degree angle with the horizontal; outer whorl face with a gentle concave zone as wide as, and occurring immediately below, the selenizone; whorl face continuing subcircularly to the umbilical suture; sutures incised, moderately deep, situated about the width of the selenizone from the lower border of the selenizone of the preceding whorl; nucleus apparently simple, smooth, normally dextral; base rounded, widely phaneromphalous; parietal, columellar and outer lips unknown; outer lip probably with a broad, shallow slit generating a flat selenizone at the juncture of the upper and outer whorl faces; outer lip presumably leaves upper suture with a moderate backward obliquity and gentle forward convexity, continuing below the selenizone subvertically with a gentle forward convexity; selenizone bounded by two fine revolving lirae; lunulae crescentic, fine; ornamentation consisting only of selenizone and fine growth lines; uncooling common, occurring at any stage of development; shell septate in early whorls. The holotype is 14 mm in width, 6 mm in height, and has a pleural angle of 146 degrees.

*Remarks.* — This species is distinguishable from the type species *Euryzone delphinuloides* (Schlotheim) by being less than one-half as large and lower spired, and by having the selenizone located higher on the outer whorl face.

Uncoiling is fairly common in this species and may take place at any time after the third volution, or it may not occur at all as in paratype, No. 40356, which is the largest specimen in the collection. The disposition of the free whorl is erratic. In the holotype, No. 40462, and paratype, No. 40382, the final free whorl is elevated

above the level of the penultimate whorl; in paratypes, Nos. 30689 and 40457, the free whorl is in the normal plane of coiling but is deflected outward slightly; in paratypes, Nos. 40459, 40464, the ultimate free whorl is deflected far away from the preceding whorls and considerably depressed. In paratypes, Nos. 30673, 40460, the final whorl is in the normal plane of coiling but is deflected so far out as to be almost straight. Paratype, No. 40463, is an internal mold showing widely spaced septa irregularly distributed throughout a considerable portion of the shell, up to the final whorl.

The trivial name of this species *petilitornata* is derived from the Latin *petilus* meaning "slender" and *tornatus* meaning "revolve" and refers to the slender whorls of this species.

*Occurrence.* — Locality A — 32 specimens; Locality B — 13 specimens; Locality C — 55 specimens.

*Types.* — Holotype, No. 40462; figured paratypes, Nos. 30672, 30673, 30689, 40321, 40356, 40382, 40458, 40459, 40463, 40464; unfigured paratypes. Nos. 30679, 40457, 40460, 40465, 40516.

**Euryzone latitornata** Linsley, n. sp. Pl. 29, figs. 2a-c; Pl. 30, figs. 2a-c

*Description.* — Moderately small, low-spired, turbiniform gastropods with a broad whorl and with a sinus in the outer lip culminating in a broad, probably shallow notch which generates a broad selenizone at the juncture of the upper and outer whorl faces; upper whorl face gently arched, sloping outward and downward from upper suture of neanic whorls, roundly subhorizontal in ephebic whorls; broad, flat to arched selenizone located at juncture of upper and outer whorl faces, sloping downward and outward at about a 45 degree angle with the horizontal; outer whorl face rounded below selenizone, then sloping flatly inward towards base which is rounded to the umbilical shoulder; sutures incised, moderately deep, situated about the width of the selenizone from the lower border of the selenizone of the preceding whorl; nucleus simple, smooth, normally dextral; base poorly known, rounded, narrowly phaneromphalous; umbilical shoulders not pronounced; parietal, columellar and outer lips unknown; outer lip probably with a broad, shallow slit generating a flat selenizone at the juncture of the upper and outer whorl faces; outer lip presumably leaving upper suture with a moderate backward obliquity and gentle forward convexity to the

selenizone, continuing below the selenizone subvertically with gentle forward convexity; selenizone bounded by two fine revolving lirae; lunulae crescentic, fine; ornamentation consisting only of selenizone and fine growth lines; uncoiling unknown in specimens available; septae unknown but probably present. The holotype is 15.0 mm in width and 8.0 mm in height, with a pleural angle of 162 degrees for the adult and 116 degrees for the neanic whorls.

*Remarks.* — This species can be distinguished from *Euryzone petilitornata,* n. sp., because it has broader and deeper whorls and, consequently, fewer whorls in shells of the same diameter. It also differs from *E. petilitornata* in having the upper whorl face broadly rounded rather than flat, and from *Euryzone pharkidopyndax,* n. sp., in having a smooth base.

This species is known from six specimens collected from the quarry of the Solvay Process Company at Sibley, Wayne County, Michigan. Unfortunately, only the holotype shows the base, and this is poorly preserved. The upper surfaces of all specimens are well preserved, showing growth lines and a well-formed selenizone. Paratype, No. 40461, differs from the other specimens in having a strongly convex selenizone and narrow grooves bordering the selenizone so that the surface of this structure is slightly raised above the level of the shell instead of being slightly depressed below the surface as in the holotype and the other paratypes. These differences are probably a result of the loss of the outer shell layer of this specimen; thus we have a cast of the surface of the inner shell layer.

The trivial name of this species *latitornata* is derived from the Latin *latus* meaning "broad" and *tornatus* meaning "revolve" and refers to the broad whorls of this species.

*Occurrence.* — Locality B — six specimens.

*Types.* — Holotype, No. 40466; figured paratypes, Nos. 30687, 40461; unfigured paratype, No. 30688

**Euryzone pharkidopyndax** Linsley, n. sp. Pl. 29, figs. 1a-c

*Description.* — Flatly coiled, widely phaneromphalous gastropods of medium size with a wrinkled base, and probably a shallow notchlike slit culminating in a selenizone just above the periphery; upper whorl face gently arched, subhorizontal above the selenizone, the latter being placed at the juncture of the upper and outer whorl

faces; the outer whorl face trending downward and inward from the selenizone to a strongly rounded, wrinkled circumumbilical ridge, thence continuing smoothly inward and upward to the umbilical shoulder; sutures located slightly below the selenizone of preceding whorl, moderately incised and moderately deep; nucleus poorly known, apparently normally dextral; base widely phaneromphalous, the umbilicus funnel-like and deep; the earlier whorls (first three) showed a raised spire, but the final whorls becoming more swollen so that their peripheries extend above the height of the spire; columellar, parietal, and outer lips unknown; outer lip presumably leaving the upper suture subradially with slight backward obliquity which may increase near the selenizone; outer lip presumably with a notch just above the periphery; below the selenizone the outer lip continues to the collumellar lip with very slight backward obliquity; selenizone wide, flat to gently convex bounded by two fine revolving lirae; lunulae unknown, ornamentation consisting of growth lines and a rugose circumumbilical keel; shell unknown, apparently thin. The holotype, consisting of five whorls, is 22.0 mm in width and 11.0 mm in height. Its pleural angle varies greatly with age, that of the first three whorls being 104 degrees and that of the adult whorls 162 degrees.

*Remarks.* — This species is known from only one specimen which is almost complete and fairly well preserved. However, it may easily be recognized by two distinctive structures, the swollen adult body whorl and the wrinkled base. The swollen body whorl is obviously an adult character. Wrinkles, like those on the base, probably are present on all whorls except the earliest; this is strongly indicated by the fact that the corrugations on the base of the body whorl are more distinct on the younger than older parts of this whorl.

*Euryzone pharkidopyndax,* n. sp. may be distinguished from *E. petilitornata,* n. sp. by its wrinkled base, and its whorls are relatively wider and deeper per volution than those of *E. petilitornata,* n. sp. It resembles *E. latitornata,* n. sp. in whorl width and depth but differs from this species in having a wrinkled base and a swollen adult body whorl.

The trivial name of this species, *pharkidopyndax,* is derived from the Greek *pharkidos* meaning "wrinkled" and *pyndax* mean-

ing "bottom of a cup or other vessel" and refers to the wrinkled nature of the base.

*Occurrence.* — Locality B — one specimen.

*Types.* — Holotype, No. 40509.

**Euryzone** ? sp. "A" Pl. 30, figs. 3a, b; Pl. 31, figs. 1a-d

*Remarks.* — A large number of specimens collected from the Anderdon Limestone of the Brunner, Mond Canada Ltd. quarry are here designated as *Euryzone* ? sp. "A." They are large, discoidal, septate gastropods with a broad shallow sinus in the outer lip that does not give rise to a selenizone. The upper whorl face is flattened, sloping downward and outward from the upper suture at a 60 to 70 degree angle to the vertical. The outer whorl face is gently arched, subvertical, joining the upper whorl face with a pronounced angularity. The base is gently rounded, joining the outer whorl face roundly, and thence gradually rounded to the umbilical suture. The base is widely phaneromphalous. The upper suture is sharp, strongly incised, situated one-third to one-half way down the outer face of the preceding whorl. The umbilical suture is sharp, not incised. The columellar, parietal, and outer lips are unknown, but the outer lip aparently leaves the upper suture with a strong backward obliquity to a broad, shallow sinus at the juncture of the upper and outer whorl faces. It continues below the sinus with a strong forward obliquity to the juncture of the outer whorl face and the base where it reverses itself roundly to a strong backward obliquity with a marked forward concavity, so that it is subradial by the time it reaches the umbilical shoulder. The sinus does not generate a selenizone. The ornamentation consists only of faint growth lines. The shell is thick, with numerous thick septae occurring irregularly throughout the shell up to one-half whorls distance from the aperture. The shell structure is unknown. Figured specimen, No. 40407 consists of four (+) whorls; it is 29.5 mm in height and 65.0 mm in width, and has a pleural angle of 140 degrees.

Because representatives of this species are poorly preserved and no one specimen shows all of the described characteristics, I have not established a new species on this form.

This species is limited to the uppermost part of unit 16 (the uppermost bed) of the Brunner, Mond Canada Ltd. quarry; at some

places in the quarry it is common. Only *Euryzone* ? sp. "A" and *Euryzone* ? sp. "B" occur at this stratigraphic position. Probably the most interesting thing about these two species is their unique mode of preservation at the Brunner, Mond Canada Ltd. quarry. They occur as natural molds, most of which are poorly preserved. Evidently their shells were buried in the lime muds deposited during Anderdon time and uplift and retreat of the sea occurred soon after. The shells were then dissolved away leaving natural molds which were then exposed by erosion. The sea, which deposited the overlying Dundee Limestone, then invaded the area, and the basal sediments of this sea filled the molds. Thus these fossils, as they are now found, have molds and casts of different ages and an erosional disconformity in each fossil! It is probable that the period of erosion had much to do with the poor state of preservation of these fossils.

The assignment of these specimens to the genus *Euryzone* is provisional and is based primarily on the presence of a deep sinus as revealed by a study of the growth lines. It is possible that they belong to *Straparollus (Euomphalus)* rather than *Euryzone,* but their final taxonomic position will have to await the acquisition of better material than is now available.

*Occurrence.* — Locality E — 24 specimens.

*Figured specimens.* — Nos. 40406, 40407, 40409, 40413.

**Euryzone** ? sp. "B" Pl. 31, fig. 4

*Remarks.* — Several specimens, obtained from the Anderdon Limestone of the Brunner, Mond Canada Ltd. quarry, are here assigned to *Euryzone* ? sp. "B." They are large, high turbiniform septate gastropods with a broad shallow sinus in the outer lip which does not give rise to a selenizone. The upper whorl face is flattened, sloping downward and outward from the upper suture at an angle of approximately 45 degrees to the vertical. The outer whorl face is gently arched, subvertical, joining the outer whorl face subangularly. The base is gently rounded, joining the outer whorl face subangularly; the umbilical shoulder is rounded to the umbilical suture. The base is widely phaneromphalous. The upper suture is fairly sharp, only slightly incised, located at least two-thirds the way down the outer whorl face of the previous whorl and possibly intercepting the previous whorl at its base. The columellar, parietal, and outer lips are unknown. The outer lip apparently leaves the

upper suture with a moderate backward obliquity to a broad, shallow sinus at the juncture of the upper and outer whorl faces, then continuing below the sinus with a moderate forward obliquity to the juncture of the outer whorl face and the base where it again reverses its direction to a strong backward obliquity with a marked forward concavity. The sinus does not generate a selenizone. The ornamentation consists only of faint growth lines. The shell is thick with thick septa occurring irregularly throughout the shell to a distance from the aperture equal to one-half a whorl's length. The shell structure is unknown. Figured specimen, No. 40408, consists of six (+) whorls, is 9.25 mm in height and 40 mm in width, and has a pleural angle of 75 degrees.

This species is preserved primarily as natural casts composed of light buff, dolomitic, Dundee Limestone with inclusions of quartz sand; the casts are within a light bluish-gray, finely crystalline limestone of the Anderdon Formation. (See the remarks under *Euryzone* sp. "A".) Figured specimen, No. 40408, was far enough below the erosional surface to escape being filled with Dundee Limestone; it was filled with a solid mass of calcite crystals that fortunately fused together to form a natural internal cast and fell out of the rock when the specimen was cracked open, leaving a relatively clean external mold. Many other specimens were completely filled with calcite; unfortunately, however, the fillings became tightly fused to the molds and will not break away cleanly from the molds. The use of acid to remove the crystalline calcite from the molds has been to no avail; the molds are in a pure limestone and hence are disolved as rapidly in acid as are the calcite crystals themselves.

*Occurrence.* — Locality E — eight specimens.

*Figured specimen.* — No. 40408.

Tribe PLANOZONIDES Knight, 1956

Genus **CATASCHISMA** Branson, 1909

*Cataschisma* Branson, 1909, p. 43.

*Type specimens.* — *Cataschisma typa* Branson, 1909, by original designation.

**Cataschisma** (?) sp. Pl. 30, figs. 1a, b

*Remarks.* — One fairly well-preserved incomplete specimen, ob-

tained from the Brunner, Mond Canada Ltd. quarry, is provisionally assigned to the genus *Cataschisma*. The gastropod may belong to an undescribed genus. Unfortunately, the single specimen does not show the base and consequently its definite taxonomic position cannot be ascertained until other more complete specimens are available.

The specimen is moderately large, globose, and naticiform, with deeply embracing whorls and probably with a broad sinus in the outer lip culminating just above the periphery of the whorl that gives rise to a selenizone (pseudoselenizone?). The whorl profile is usually gently arched between the sutures with the body whorl gently concave for a short distance below the suture, then gently convex to the selenizone whence it becomes more strongly convex to form the periphery and presumably continues convexly to the umbilicus. Each whorl embraces the preceding whorl up to the lower boundary of the selenizone. The sutures are shallow and only the presence of the selenizone breaks the even contour of the whorls. The nucleus and base are unknown. The parietal and columellar lips are unknown; the outer lip, which is poorly known, probably extends from the upper suture with a moderate backward obliquity and continues with no curvature to the location of the selenizone where there presumably is a shallow, but broad notch. The selenizone is broad and slightly depressed below the surface of the shell. The lunulae are unknown; ornamentation or growth lines are unknown.

*Occurrence.* — Locality D — one specimen.

*Figured specimen.* — No. 40506.

## Suborder TROCHINA Cox and Knight, 1960

## Superfamily PLATYCERATACEA Hall, 1859

### Family **PLATYCERATIDAE** Hall, 1859

### Genus **PLATYCERAS** Conrad, 1840

*Platyceras* Conrad, 1840, p. 205.

*Type species.* — *Pileopsis vetusta*, J. de C. Sowerby, 1829, p. 223, by subsequent designation, Tate, 1869, p. 34.

**Platyceras (Platyceras)** sp. Pl. 37, figs. 2a, b

*Remarks.* — A single platyceratid was found in the Brunner,

Mond Canada Ltd. quarry. It is a poorly preserved specimen, apparently a natural internal mold with a small piece of replaced shell material clinging to its outer surface. The specimen is an irregularly horn-shaped gastropod of medium size. The first whorl has been broken away and lost but was apparently coiled and in contact for a short distance. The last whorl is free, irregularly shaped, and expands rapidly. There is a broad, slightly concave area on the inner flanks of the whorl on the right side, and possibly a similar depression on the left side which is poorly discernable because of the preservation. Ornamentation is unknown, but it probably consisted only of growth lines. The aperture is poorly known.

*Occurrence.* — Locality D — one specimen.

*Figured specimen.* — No. 40504.

Superfamily **MICRODOMATACEA** Wenz, 1938

Family **MICRODOMATIDAE** Wenz, 1938

Genus **PAGODEA** Perner, 1903

*Pagodea* Perner, 1903, expl. pl. 64.

*Type species.* — *Pagodea concomitans* Perner, 1903, expl. pl. 64, by monotypy.

**Pagodea falcatinoda** Linsley, n. sp. Pl. 38, figs. 1a, b

*Description.* — Moderately high-spired gastropods with a strongly oblique outer lip; whorl profile flattened between sutures, not adpressed; sutures moderately shallow; base gently rounded, anomphalous; columellar lip thin, arcuate, not reflexed; parietal lip poorly known, but apparently with a thin inductura; outer lip poorly shown, apparently thin, unreflexed and with a strong obliquely backward slope away from upper suture, and rounding to an almost radial direction on the base; the ornamentation of the neanic whorls consisting of strong costae; the ephebic whorls have strong growth lines which intersect at the basal angulation with a revolving ridge to create fine, crescentic nodes; besides the basal revolving ridge there is a ridge at the upper border of the whorl and another slightly above the mid-point of the whorl, all three revolving ridges being interrupted by the transecting growth lines; shell thin, its structure unknown. Holotype consists of four ephebic whorls, is 6 mm in height and 4 mm in diameter, and has a pleural angle of 45 degrees.

*Remarks.* — This species resembles the type species of *Pagodea, P. concomitans* Perner, in general form and ornamentation but differs from it in being less than half as large, in not having the upper part of the whorl adpressed, and consequently having deeper sutures. The growth lines of *P. falcatinoda,* n. sp. are less well developed on the body whorl than are those of *P. concomitans.* The revolving ornamentation of *P. falcatinoda,* n. sp. is stronger than that of the type species, especially with regard to the nodelike development of the basal revolving ridge.

*Pagodea falcatinoda* apparently is the first representative of the genus *Pagodea* from the Middle Devonian strata, and seems to be midway in development of shell characteristics between the Lower Devonian Pagodeas and new genus *Copidocatomus,* n. gen. from the upper beds of the Anderdon of Brunner, Mond Canada Ltd. quarry. *Copidocatomus* shows strong development of the upper and lower revolving bands although the intermediate band in this genus has become sufficiently faint so as to be regarded as completely absent. The base of *Copidocatomus* is flat and joins the outer whorl face with a sharp angulation which is emphasized by the lower revolving ridge. The shell features of *Pagodea falcatinoda,* n. sp. suggests *Copidocatomus* to the author by having stronger revolving ornamentation than the Lower Devonian species of *Pagodea* and also by having deeper sutures and a somewhat more angular base.

This species is based on only one well-preserved specimen from the quarry at Sibley, Michigan.

The trivial name of this species, *falcatinoda,* is derived from the Latin *falcatus,* meaning "sickle-shaped," and *nodus,* meaning "knot" or "swelling" and refers to the curved nodes at the juncture of the base and the outer whorl face.

*Occurrence.* — Locality B — one specimen.

*Types.* — Holotype, No. 40384.

### Genus **COPIDOCATOMUS** Linsley, n. genus

*Type species.* — Here designated as *Copidocatomus collarus* Linsley, n. sp.

*Description.* — Small, trochiform gastropods with a flattened base and sharply angular, narrow shoulder; whorl face flat, bounded by two revolving lirae, one at the shoulder and one at the base;

sutures sharply marked but shallow; growth lines thickened, slanting obliquely backward from shoulder to periphery, then continuing onto the base in a less oblique manner; anomphalous; aperture unknown; nucleus unknown; ornamentation consisting of growth lines and two strong revolving lirae, one at the upper edge of the whorl face and one at the lower edge.

*Remarks.* — This genus apparently is closely related to and posibly evolved from the Lower-Middle Devonian genus *Pagodea* Perner, 1903, possibly evolving directly from *P. falcatinoda,* n. sp. (assuming that *P. falcatinoda* existed prior to Anderdon time). *Copidocatomus* may be distinguished from *Pagodea* in having a flat whorl face, sharply incised sutures, a flattened base, and an angular juncture at the contact of the outer whorl face with the base.

The generic name *Copidocatomus* is derived from the Greek *kopidos* meaning "cleaver" and the Latin *catomus* meaning "shoulder" referring to the sharp revolving lira at the shoulder.

**Copidocatomus collarus** Linsley, n. sp. Pl. 38, figs. 2a-d

*Description.* — Small, trochiform gastropods with shallow but angular shoulders and a flat whorl face; whorl profile extending flatly outward from suture for a short distance to angular shoulder, then continuing flatly downward and outward to periphery whence it turns in sharply to create a sharp ridge before continuing onto the nearly flat but gently arched base; sutures shallow, but sharply marked; nucleus unknown; base anomphalous; columellar and parietal lips unknown, but probably having a strong backward obliquity from the shoulder to the periphery with a slight forward convexity, then continuing onto the base with less backward obliquity and slight forward concavity; ornamentation consisting of rugose, somewhat irregular growth lines following the pattern of the hypothetical outer lip as described above; other ornamentation consisting of a revolving ridge at the position of the shoulder and a second revolving ridge at the position of the periphery, so that the flat whorl face is bounded by these two ridges, giving an angular appearance to the whorls; slight indication of a third revolving ridge occuring at midwhorl; shell material unknown. The holotype is 4.5 mm in height and 3 mm in diameter, with a pleural angle of about 30 degrees.

*Remarks.* — This species is known only from one complete specimen and one incomplete specimen; however, these specimens show sufficiently diagnostic structures to warrant description. The primary distinguishing characteristics are the flat whorl face bounded by revolving ridges, which create an angular shoulder (whence the generic name) and an angular periphery. Other characteristics of note are the sharply incised but shallow sutures and the roughened growth lines that slope backwards quite obliquely from the shoulder.

The trivial name *collarus* is from the Latin meaning "collared" and refers to the high shoulder and flat whorl face which gives the impression that each whorl is wearing an old-fashioned high collar popular during the early 1900's.

*Occurrence.* — Locality C — two specimens.

*Types.* — Holotype, No. 40381; paratype, No. 40383.

### Genus **MICRODOMA** Meek and Worthen, 1867

*Microdoma* Meek and Worthen, 1867, p. 267.
*Pleurotrochus* Grabau, 1910, p. 179; Knight and Bridges (*in* Shimer and Shrock), 1944, p. 471.

*Type species.* — *Microdoma conicum* Meek and Worthen, 1867.

**Microdoma tricarinata** (Grabau) Pl. 36, figs. 6a-r

*Pleurotrochus bicarinatus nomen nudum* Sherzer and Grabau, 1909, p. 550.
*Pleurotrochus tricarinatus* Grabau, 1910, pp. 179-181, pl. 27, figs. 1, 2; Wenz, 1938, p. 389, fig. 935; Knight, 1941, pp. 260, 261; pl. 54, fig. 7.

*Discussion.* — In 1909 Sherzer and Grabau published an annotated fossil list which includes the following entry on page 550: "*Pleurotrochus bicarinatus* Grabau manuscript, gen. et sp.; type similar to the strongly spinose '*Murchisonia*' of the Upper Siluric of Gotland, of which several are referred to this genus." I do not accept this as an adequate description of the species and thus consider *Pleurotrochus bicarinatus* Sherzer and Grabau a *nomen nudum.* In 1910 Grabau (pp. 179-181) published a description of this new genus and species with illustrations under the name *Pleurotrochus tricarinatus;* thus Grabau's 1910 description should be treated as the original description of the genus and species.

*Description.* — The species was redescribed by Knight (1941, pp. 260, 261) as follows:

Small, relatively high-spired, trochiform gastropods with a straight outer lip and with three revolving carinae bearing nodes or short spines; whorl profile rather flatly arched; sutures sharply incised, moderately deep; base unknown but probably somewhat flattened; nucleus unknown; columellar and parietal lips unknown; outer lip seemingly straight and without slit, notch, or sinus; ornamentation on the earlier whorl known, not the protoconch), seemingly fine lines of growth alone, on the next whorl relatively strong, sharp, transverse costae which may possibly have been varix-like with a tendency toward the formation of a node at the lower end of each costa, on the next two whorls known, presumably ephebic, the costae have disintegrated into three revolving rows of nodes, possibly spinelike in character, the nodes of the lowest row representing the incipient nodes of the costae of the costate stage the largest and fewest in number, the nodes of the two upper rows smaller and more numerous, the middle row of nodes being the weakest; shell structure unknown. The holotype must have measured about 6 mm. in height originally on the assumption that it is not merely the tip of a larger shell, and about 3 mm. in width. Its pleural angle is approximately 45 degrees.

*Remarks.* — Grabau's holotype is a poorly preserved specimen with only one-third of a whorl face visible, the base broken and missing. Subsequent collecting has provided over 125 specimens; most of these are better preserved than Grabau's type and have structures that clearly indicate the morphology of the species. The unfortunate preservation of the holotype creates the impression that the whorl profile is flatly arched, whereas in most other specimens the whorl profile is broadly rounded with a distinct shoulder created by the uppermost revolving sets of nodes. Except for the irregularities created by the ornamentation, the whorl cross-section is usually subcircular in outline with a flatly arched whorl profile a relative rarity. The height of the spire is variable with the pleural angle ranging from 36 to 64 degrees. In general the young specimens tend to have a wider pleural angle than the adult specimens. The base, unknown in the holotype, is broadly rounded and minutely phaneromphalous. The ornamentation is variable, consisting only of growth lines in the first whorl which become strong, varix-like, transverse costae on the ephebic whorl. On the final whorls of most shells the transverse costae are broken up into three revolving sets of nodes. The bottom row of nodes is absent in some specimens whereas in others each node is elongated into a long flangelike protuberance which may continue part way onto the base of the whorl. Three specimens are well enough preserved to show growth lines that slope from the upper suture with only a slight

backward obliquity and a moderate forward convexity. On no specimen can I find any trace of a fourth "non-spinose or tuberculate carina below the lower row of spines" mentioned by Grabau in his original description (1910, p. 180). He was apparently describing a line representing the broken base of his holotype. The aperture is unknown except for the basal part of the outer lip and the columellar lip, both of which show a slight thickening.

This species bears no relationship to *Murchisonia imbricata* Lindström as Grabau (1910, p. 181) suggested nor does it have any affinites to *Acanthonema* Grabau as Wenz (1938, p. 389) suggested. Now that better specimens are available, it is apparent that this is congeneric with *Microdoma* Meek and Worthen, 1867 (p. 269) as proposed by J. B. Knight and Josiah Bridge (*in* Shimer and Shrock, 1944, p. 471).

*Occurrence.* — Locality A — 135 specimens.

*Types.* — Holotype, No. 12175A; figured hypotypes, Nos. 40393, 40394, 40395, 40396, 40399, 40400, 40401, 40402, 40403, 40404, 40484, 40502; unfigured hypotypes, Nos. 40397, 40398.

Superfamily **ANOMPHALACEA** Wenz, 1938

Family **ANOMPHALIDAE** Wenz, 1938

Genus **ISONEMA** Meek and Worthen, 1866

*Isonema* Meek and Worthen, 1866B, p. 251.

*Types species.* — *Isonema depressum* Meek and Worthen, 1866, by original designation.

**Isonema ? corrugata** (Stauffer) Pl. 36, figs. 5a, b

*Straparollus corrugatus* Stauffer 1909, p. 194, pl. 16, fig. 10.

*Remarks.* — One specimen was found in the Solvay Process Company quarry at Sibley, Michigan, which may possibly be conspecific with the form from the Eversole chert zone of the Columbus Limestone that Stauffer (1909, p. 194) identified as *Straparollus corrugatus*. Stauffer only reported one specimen from the Eversole Chert and I have only one specimen from the Anderdon Limestone. Two small specimens from the France Stone Company quarry, which may represent young individuals of this species, are subsequently described as ? *Isonema ? corrugata* (Stauffer).

The shell from the Anderdon Limestone is that of a small, low-spired trochiform gastropod with a moderately oblique outer

lip. The whorl profile is strongly arched between the sutures and is subelliptical in outline, the base being somwhat more inflated than the crest of the whorl. The nucleus is poorly shown but apparently is normally dextral and smooth. The base is rounded and the umbilical region is poorly shown; it apparently is minutely phaneromphalous. The columellar, parietal, and outer lips are unknown. Judging from the collabral ornamentation, the outer lip slopes obliquely backward from the upper suture with no forward convexity or concavity. The ornamentation consists of fairly well-developed collabral elements with interspaces of about equal in size to these elements. Hypotype, No. 40518, is 2 mm in height and 2.75 mm in diameter, and has a pleural angle of 80 degrees.

Stauffer was surely in error in considering his specimen as belonging to the genus *Straparollus*. I have tentatively placed this form in the genus *Isonema* Meek and Worthen (1866 B, p. 251), though it fits equally well in the genus *Straparella* Fischer (1885, p. 829). More positive identification will be impossible until specimens are acquired which show more completely the nature of the umbilicus and aperture.

*Occurrence.* — Locality B — one specimen.

*Types.* — Hypotype, No. 40518.

**?Isonema ? corrugata** (Stauffer) Pl. 36, figs. 4a-d

*Remarks.* — Two specimens were collected from the quarry of the France Stone Company near Sylvania, Ohio, which I have provisionally assigned to *Isonema corrugata* (Stauffer). The specimens, presumably young shells, are small, rotelliform gastropods with no visible sinus in the outer lip. The whorl profile is strongly arched between the sutures and broadly rounded at the periphery. The sutures are sharply incised but shallow. The nucleus is dextral and unornamented. The base is rounded; although it is unknown whether an umbilicus is present, the shell probably is minutely phaneromphalous. The columellar, parietal and outer lips are unknown; presumably the outer lip is straight with no sinus or slit. Judging from the growth lines, the margin of the outer lip slopes backward from the upper suture with a moderate backward obliquity to the periphery and continues below the periphery with a gently backward

obliquity. There is no ornamentation other than moderately strong growth lines.

One of the two specimens, No. 40405, gives the impression of having some faint revolving ornamentation and may possibly be a young specimen of *Nodonema granulatum* Linsley, n. sp., lacking a selenizone. If a selenizone is present, it is too indistinct to be positively recognizable. Specimen, No. 40405, is 1.9 mm in height and 2 mm in width, and has a pleural angle of 108 degrees; the other specimen, No. 40508, has a height of 1.8 mm, a width of 1.8 mm, and a pleural angle of 109 degrees.

*Occurrence.* — Locality A — two specimens.

*Figured specimens.* — Nos. 40405, 40508.

Suborder doubtful (TROCHINA?)

Superfamily **PSEUDOPHORACEA** S. A. Miller, 1889

Family **PSEUDOPHORIDAE** S. A. Miller, 1889

*Scalactrochus* Etheridge, Jr., 1890, p. 66.

*Type species.* — *Trochus (Scalaetrochus) lindströmi* Etheridge, Jr., 1890, p. 66, by monotypy.

**Scalaetrochus fragosus** Linsley, n. sp. Pl. 37, figs. 1a-g

*Description.* — Large trochiform, anomphalous, (cryptomphalous?) gastropods with a flat to slightly concave base and sharply angular periphery; outer lip sloping downward with a strong backward obliquity and moderate forward convexity; whorl profile slightly convex just below upper suture, gradually turning to slightly concave, ending in a short frill overhanging the lower suture; whorl face sloping outward at an angle of about 45 degrees from the vertical; sutures distinct, deeply incised beneath short overhanging frill; nucleus unknown; base of shell flat to slightly concave with angular periphery; anomphalous (cryptomphalous?); columellar lip poorly known, apparently slightly thickened, forming an inductura on the base that may be continuous with a thin parietal inductura; columellar inductura covering umbilicus (if present); parietal lip unknown; outer lip unknown, apparently leaving upper suture with moderate backward obliquity gradually changing to a strong backward obliquity at the periphery, resulting in a moderate forward convexity; form of lip on base unknown; no selenizone; ornamentation consisting of a short flange at the periphery and

growth lines, varying from fine to rugose in intensity; shell material unknown. Holotype consisting of eight or more whorls, is 58 mm in height, 65 mm in estimated maximum width, and a pleural angle of 69 degrees.

*Remarks.* — This species greatly resembles the type species *Scalaetrochus lindströmi* Etheridge, Jr. (1890, p. 66) in general form, size, and ornamentation. It differs from *S. lindströmi* in having the growth lines more irregular, in having a short, simple flange which overhangs the sutures and in having the whorl face convex at the top leading to a sharply incised suture underlying the flange of the preceding whorl. *S. fragosus,* n. sp. is known from 18 specimens collected from the Brunner, Mond Canada Company Limited quarry. Most of the specimens are fragmentary and the molds of this genus appear to have been especially susceptible, perhaps due to its large size, to subsequent growth of calcite crystals in the molds, and this factor combined with the fusion of the large steinkern with the mold causes the preservation to be poor in most instances. These are the largest gastropods so far uncovered in the Anderdon fauna.

The trivial name of this species, *fragosus,* is Latin meaning "rough or uneven" and refers to the roughened growth lines.

*Occurrence.* — Locality D — 18 specimens.

*Types.* — Holotype, No. 40430; paratypes, Nos. 40353, 40363, 40431, 40432, 40433.

Suborder NERITOPSINA Cox and Knight

Superfamily **NERITACEA** Lamarck, 1809

Family **NERITOPSIDAE** Gray, 1847

Subfamily **NATICOPSINAE** S. A. Miller, 1889

Genus **NATICOPSIS** M'Coy, 1844

Subgenus **N. (NATICOPSIS)** M'Coy, 1844

*Naticopsis* McCoy, 1844, p. 33.

*Type species.* — *Naticopsis phillipsi* M'Coy, 1844, p. 33, by subsequent designation of Meek and Worthen, 1866A, p. 364, footnote.

**Naticopsis (N.) pegmihumerosa** Linsley, n. sp. Pl. 38, figs. 5a-c

*Description.* — Medium-sized, naticiform gastropods without a

sinus in the outer lip; whorl profile with a flattened, narrow shoulder next to the upper suture, then proceeding outward and downward flatly to the periphery which is rounded and situated high on the whorl; whorl profile continuing with a gentle rounding to the base; spire low; base extended, anomphalous; columellar lip gently flaring in mature individuals; parietal inductura thickened, confluent with outer and columellar lips with no interruptions; outer lip flaring at the base, thin at the periphery and thickened at the top; the inner surface of the upper part of the outer lip with a broad groovelike area next to the suture which slants downward into the aperture causing the upper part of the upper lip to be sharp; nucleus unknown; ornamentation consisting of fine growth lines with a moderate backward obliquity of about 30 degrees; operculum unknown. Holotype consisting of about four whorls, 20 mm in height, 16 mm in width, and having a pleural angle of 94 degrees.

*Remarks.* — This species resembles the type species *Naticopsis phillipsi* M'Coy in general form and ornamentation. It differs from the type species in having a narrower shoulder and in having the columellar, parietal, and outer lips confluent with each other, and in having a higher spire.

The trivial name for this species *pegmihumerosa* is derived from the Latin *pegma* meaning "shelf" and *humerus* meaning "shoulder" and refers to the flattened shoulder of this species.

The three species of *Naticopsis* from the Anderdon Limestone can be distinguished from each other by the following characteristics. *N. (N.) opimavoluta* Linsley, n. sp. and *N. (N.) planifrons* Linsley, n. sp. are both higher spired than *N. (N.) pegmihumerosa* Linsley, n. sp. *N. (N.) opimavoluta* is by far the more robust of the three species, its whorl height to whorl width ratio being on the order of 1/1.5, whereas the same ratio for *N. (N.) planifrons* is closer to 1/1 and for *N. (N.) pegmihumerosa* is 1/0.85. *N. (N.) pegmihumerosa's* main distinguishing structures are the flattened, narrow, shelflike shoulder and the low spire.

The robust species *N (N.) opimavoluta* conforms well with group 1 ("the group of *Naticopsis subovatus* Worthen"), as suggested by Knight, (1933B, p 363). *N. (N.) planifrons* seems to best fit with ephebic stages of group 3 ("the group of *N. ventricosa*," Knight

*op. cit.*). whereas *N. (N.) pegmihumerosa* does not fit any of the three groups of the Pennsylvanian naticopsids suggested by Knight and probably represents a stock which did not live to Pennsylvanian time. One specimen of *N. (N.) pegmihumerosa* has a faint suggestion of nodes and could conceivably represent a descendant of the form which gave rise to the *Turbonitella-Trachydoma* lineage or more probably represents convergence on the line of *N. (Jedria)* Yochelson.

Both *N. (N.) opimavoluta* and *N. (N.) pegmihumerosa* [and presumably *N. (N.) planifrons*] differ from typical naticopsids in that the outer lip is completely confluent with the parietal inductura and columellar lip. They lack the typical "excurrent notch" at the upper suture, though this may be foreshadowed by the broad, groove-like area in the uppermost part of the outer lip.

*Occurrence.* — Locality D — three specimens.

*Types.* — Holotype, No. 40350; figured paratypes, Nos. 40352, 40360.

**Naticopsis (N.) opimavoluta** Linsley, n. sp. Pl. 38, figs. 3a-c

*Description.* — Moderately large, naticiform gastropods without a sinus in the outer lip; whorl profile except for a flat, narrow shoulder next to the suture; uniformly arched and subcircular in outline; sutures sharp, moderately incised, situated at or just beneath the periphery of the previous whorl; spire relatively high; base rounded, anomphalous; columellar lip broadly flaring in mature individuals; parietal inductura thickend, slightly arcurate and completely confluent with outer and columellar lips; outer lip flaring at the base, thin at the periphery and slightly reflected at the top where it becomes confluent with the parietal inductura; nucleus unknown; ornamentation consisting only of fine growth lines; growth lines nearly perpendicular to the upper suture with a slight forward convexity; operculum unknown; shell thick, its structure unknown but apparently consisting of two distinct layers. Holotype, consisting of four (+) whorls, 21 mm in height and 18 mm in width, and having a pleural angle of 97 degrees.

*Remarks.* — This species resembles the type species *Naticopsis phillipsi* M'Coy in general form and ornamentation but differs from

it in being higher spired, in having a more acute pleural angle, and in having the columellar lap and the basal and upper portions of the outer lip flaring. The diagnostic features of *N. (N.) opimavoluta,* n. sp. are the sub-circularity of the whorl profile, the narrowness of the shoulder and its relatively high spire.

Two specimens of *N. (N.) opimavoluta* were collected whose shells had been replaced by coarsely crystalline calcite. These reveal the shell to be thick and apparently composed of two layers. One of these shells was broken approximately on an axial cross-section; it was ground down and photographed to show what little can be learned from neritacean cross-sections.

The trivial name of this species, *opimavoluta,* is derived from the Latin *opimus* meaning "well-fed or fat" and *voluta* meaning "spiral" and alludes to the rotundity of this species.

*Occurrence.* — Locality D — eight specimens.

*Types.* — Holotype, No. 40354; figured paratype, No. 40365; unfigured paratypes, Nos. 40351, 40357, 40364.

**Naticopsis (N.) planifrons** Linsley, n. sp. Pl. 38, figs. 4a-d

*Description.* — Medium-sized, naticiform gastropods without a sinus in the outer lip; whorl profile flattened between a sharply rounded shoulder and rounded subangular periphery, continuing with gentle curvature below the periphery; sutures sharp, deeply incised, located just above the periphery of the preceding whorl; spire high; base extended, anomphalous; columellar lip unknown, presumably flaring in mature individuals; parietal inductura unknown; outer lip unknown, probably flaring at the base and thin at the periphery; nucleus unknown; ornamentation consisting of growth lines, having a slight forward concavity and a backward obliquity of about 30 degrees; operculum unknown. Holotype consisting of about four whorls, 15 mm in height and 11 mm in width, with a pleural angle of 86 degrees.

*Remarks.* — This species resembles the type species *Naticopsis phillipsi* M'Coy in general form and ornamentation but differs from it in being higher spired, and having a more acute pleural angle and the upper whorl face somewhat flattened. It differs from *N. (N.) opimavoluta,* n. sp. in having the whorl height slightly greater than the whorl width and in having a smaller shell. Its simple, un-

ornamented appearance suggests that the species may be more primitive than *N. (N.) subcostata* (Goldfuss, 1844) from the Devonian of Germany which in turn suggests that *N. (N.) planifrons*, n. sp. is ancestral to the Mississippian naticopsids.

The trivial name of this species *planifrons* is derived from the Latin *planus* meaning "flat or level" and *frons* meaning "brow or or forehead" and refers to the flattened upper whorl face of this species.

*Occurrence.* — Locality D — seven specimens.

*Types.* — Holotype, No. 40359; figured paratype, No. 40355; unfigured paratypes, Nos. 40362, 40366.

Subfamily **NERITOPSINAE** Gray, 1847

Genus **TURBONITELLA** de Koninck, 1881

*Turbonitella* de Koninck, 1881, p. 72.

*Type species.* — *Turbo biserialis* Phillips, 1836, p. 226, by subsequent designation, Cossmann, 1915, p. 27.

**Turbonitella trunculinoda** Linsley, n. sp. Pl. 38, figs. 6a-c

*Description.* — Small, turbiniform gastropods with a spire of moderate height; whorl profile sharply shouldered high up on the whorl and slightly arched on the whorl face below the shoulder; sutures moderately deep and nearly vertical to form a narrow sutural probably anomphalous; collumelar lip unknown; parietal lip unknown; outer lip unknown; growth lines nearly straight with a slight backward obliquity; other ornamentation consisting of tranverse ribs, having strongly developed nodes on the shoulder and becoming indistinct about halfway down the whorl face. Holotype consisting of about seven whorls, 5.75 mm in height and 3 mm in width, with a pleural angle of 66 degrees.

*Remarks.* — This species is known from three specimens, two collected in the Solvay Process Company quarry at Sibley, Michigan, and a third poorly preserved specimen from the Brunner, Mond Canada Company Ltd. quarry. The mode of preservation of all three specimens is unusual and rare as far as the gastropods of the Anderdon Limestone are concerned. Like the other gastropods, these specimens are preserved as natural external molds, which are coated over with a thin lamina of calcite crystals so arranged as to give the appearance of revolving ornamentation. The lamina is so thin and evenly applied to the mold that the fine nodes and even

the growth lines can be seen. After careful examination of the specimens I am convinced that the only ornamentation of this species are the nodes and the growth lines.

The crystalline structure of this thin calcite lamina on first observation appears to be erratically arranged; on further examination, the crystalline pattern was found to be the same on all three specimens. This fact leads the author to the conclusion that the crystalline pattern is that of the original shell material rather than a haphazard crystal growth; it probably represents the actual crystal structure at the contact of the inner and outer shell layers of this species of *Turbonitella.* The outer shell layer is apparently cemented to the rock matrix and the mold mentioned above is, therefore, that of the surface of contact between the inner and outer shell layers. This hypothesis is supported by the fact that only this species exhibits this unusual crystal growth.

This species resembles the type species of the genus *Turbonitella biserialis* (Phillips) in general form and ornamentation and differs from the latter in being one-half as high, in having a more acute pleural angle and more deeply incised sutures, and in lacking a collar at the suture line which laps upon the previous whorl. It gives indication of being more primitive than *Turbonitella biserialis* (Phillips) in having less conspicuous nodes that are almost vertical, rather than inclined obliquely backward nodes like those of type species.

This species must represent one of the earliest forms of the Neritopsinae and presumably is closely related to *Naticopsis pegmihumerosa,* n. sp. *Turbonitella trunculinoda,* n. sp. differs from *Naticopsis pegmihumerosa,* n. sp. in being considerably smaller, in having the nodes much more well developed, and in having a more acute pleural angle.

*Occurrence.* — Locality B — two specimens; Locality C — one specimen.

*Types.* — Holotype, No. 40367; paratype, No. 40368.

## Suborder MURCHISONIINA Cox and Knight

### Superfamily **MURCHISONIACEA** Koken, 1896

### Family **MURCHISONIIDAE** Koken, 1896

### Genus **MURCHISONIA** d'Archiac and Verneuil, 1841

*Murchisonia* d'Archiac and Verneuil, 1841, p. 154.

*Type species.* — *Muricites turbinatus* Schlotheim, 1820. [*Mur-*

*chisonia bilineata* (Dechen), 1832 (p. 533)], by subsequent designation, Woodward, 1856, p. 147.

**Murchisonia (M.) akidota** Linsley, n. sp. Pl. 32, figs. 3a-c

*Murchisonia* sp. Ehlers, Stumm, and Kesling, 1951, pl. 3, fig. 22.

*Description.* — Small, high-spired gastropods with obtusely subangular periphery bearing a selenizone between two revolving lirae; whorl profile obtusely subangular at the periphery, the whorl face having a flat to slightly concave surface between the upper suture and the selenizone and a flat to slightly concave surface between the selenizone to the lower suture; sutures shallow; nucleus unknown; base poorly known, slightly flattened with angular revolving ridge falling at the line of the lower suture; anomphalous or possibly with an exceedingly small umbilicus covered by columellar lip; columellar lip poorly known, apparently slightly reflected; parietal lip unknown; outer lip unknown, but probably with a notch or slit culminating at the periphery and giving rise to a selenizone; growth lines indeterminable; selenizone concave between two strong revolving bordering lirae, the lunulae indeterminable; no ornamentation other than lirae bordering selenizone and probably faint growth lines. Holotype, No. 40322, consisting of 10 whorls (apical whorls not preserved), 7:25 mm in height and 2.25 mm at greatest width, with a pleural angle of 15 degrees. Paratype, No. 40319, consisting of 14 whorls, 7.5 mm in height and 2.5 mm at greatest width, with a pleural angle of 16 degrees. Paratype, No. 40321, consists of 16 whorls, 9 mm in height and 2.25 mm at greatest width, with a pleural angle of 14 degrees.

*Remarks.* — This species is like *Murchisonia bilineata* (Dechen) in general form and ornamentation but differs from it in being one-half as large in height, having a slightly more acute whorl profile at the periphery with the selenizone located nearer the center of the whorl, and in having a more acute pleural angle. *M. akidota,* n. sp. differs from *M. trepomena* Whidborne (1892) and *M. tricincta* Phillips (1841) (not Münster) in being about two-thirds as large, having more prominent lirae bounding the selenizone, and in having the sutures more nearly perpendicular to the axis of the shell.

Because of poor preservation, the growth lines are poorly shown, so little can be deduced about the shape of the lip.

The trivial name *akidota* is derived from the Greek *akidotos* meaning "pointed" and refers to the diagnostic feature of this species, the pointed spire and small pleural angle.

*Occurrence.* — Locality C — 15 specimens; Locality D — five specimens.

*Types.* — Holotype, No. 40322; figured paratype, No. 40319; unfigured paratype, No. 40320.

**Murchisonia (M.) anderdoniae** Linsley, n. sp. Pl. 32, figs. 4a-f

*?Solenospira? extenuatum* (Hall), Grabau, 1910, p. 176, pl. 16, fig. 7.

*Description.* — Small, high-spired gastropods with subangular periphery bearing a selenizone between two revolving threads; whorl profile subangular at the periphery with no shoulder; whorl face gently convex or nearly flat between the upper suture and the selenizone, in most specimens with a slight concavity just below selenizone, and gently convex to the lower suture; suture medium to deep; nucleus unknown; base rounded, anomphalous, and lacking a keel at the location of the lower suture; columellar lip poorly shown, in most specimens slightly thickened or reflexed; parietal lip poorly shown, apparently with a thin parietal inductura; outer lip unknown, but probably with a notch or slit culminating at or just above the periphery and forming a well-marked selenizone; selenizone a concave band situated between two strong, revolving threads; lunulae unknown; ornamentation consisting only of the selenizone and possibly faint growth lines too obscure to be of value in determining the nature of the outer lip.

Holotype, No. 40329, consists of eight whorls, 4.7 mm in height and 2.5 mm in greatest width, with a pleural angle of 41 degrees. Other specimens with greatest observed height of 6.5 mm, greatest observed width of 3.7 mm, as many as eight whorls, and pleural angles from 25 to 45 degrees.

*Remarks.* — This species resembles *Murchisonia bilineata* (Dechen) in general form and ornamentation but differs from it in being about one-half as tall, in having the selenizone located nearer to a median position between the two sutures of the whorl face, and in having the selenizone occupying a proportionately larger part of the whorl face.

*M. anderdoniae* resembles *M. minuta* Hall, 1859 (p. 298, pl.

54, fig. 17); it differs from that species in having a larger pleural angle and in having fewer but larger whorls in a given space.

This species is apparently an exceedingly variable one. I had the opportunity to study a population of over 150 specimens and found the following variations: The pleural angle varies greatly, ranging from 25 to 45 degrees, with most of the specimens having an angle between 30 to 35 degrees; the position of the selenizone in most specimens is located at the periphery of the whorl, but in others it is higher on the whorl face.

The upper whorl face of most specimens slopes sharply from the selenizone toward the upper suture, thus forming a wide angle (50-60 degrees) with the axis of the shell; in some specimens it slopes inward less sharply, forming an angle with the axis of about 30 degrees. In the former case, the upper whorl face has a flat surface and the upper suture is deep; in the latter case, involving a more acute angle, the upper whorl face tends to be more convex with a shallower upper suture. These differences have no specific value; they are variations which are found in all conceivable combinations with no apparent tendency toward speciation.

The growth lines on this species are too indistinct to be of much use in determining the form of the outer lip. From careful observation of many specimens there is some indication that the growth lines are similar to those of *Murchisonia bilineata* (Dechen); the lines seem to pass downward from the upper suture to the selenizone in a straight line with a moderate backward obliquity, and from the selenizone to the base in a straight line with a moderate forward obliquity. Most of the specimens of this species were obtained from the biostromes of the France Stone Company quarry near Sylvania, Ohio, where the species is common; only a small number of specimens occur at other localities.

An external mold of a small, high-spired gastropod from the "Detroit salt shaft," the first of two salt shafts sunk on the property of the International Salt Company at Oakwood, greater Detroit, Michigan, was identified by A. W. Grabau (1910, p. 176) with Hall's *Murchisonia extenuata*, a species which Grabau reclassified as *Solenospira? extenuatum* (Hall). R. S. Bassler (1915, p. 472) assigned the specimen of *S.? extenuatum*, described and illustrated

by Grabau (1910, p. 176, pl. 16, fig. 7), to *Ectomaria? extenuata* (Hall).

The gastropod identified by Grabau as *Solenospira? extenuatum* (Hall) is questionably conspecific with *Murchisonia (Murchisonia) anderdoniae,* n. sp. Grabau's specimen almost undoubtedly belongs to the genus *Murchisonia.* Unfortunately casts made from the specimen, a natural external mold, show that the original structures of the exterior of the shell are either so poorly preserved or are missing as the result of solution that a specific comparison is impossible. The author suggests that the specimen should be identified as *Murchisonia?* sp. (See illustration of specimen, Pl. 33, fig. 6.)

It also may be impossible to determine whether Grabau's specimen of *Solenospira? extenuatum* (Hall) is conspecific with Hall's types of *Murchisonia extenuata,* collected from the Upper Silurian Manlius Limestone of New York State, because Hall's types are poorly preserved and lack definite specific characters.

The specimen of Grabau's *Solenospira? extenuatum* (Hall) is associated with the holoype of *Pleurotrochus (=Microdoma) tricarinata* Grabau in a block of dolomitic-limestone taken from the "Detroit salt shaft." Grabau (1910, p. 176) was in error in stating that this specimen came from the Lucas Dolomite. The fact that the specimen is associated with P. *(=Microdoma) tricarinata* Grabau, an excellent guide fossil for the Anderdon Limestone, proves that this specimen is of Anderdon instead of Lucas age.

The trivial name of this species *anderdoniae* was chosen because this is the most abundant species of *Murchisonia* found in the Anderdon Limestone.

*Occurrence.* — Locality A — 159 specimens; locality B — three specimens; locality C — three specimens.

*Types.* — Holotype, No. 40329; figured paratypes, Nos. 40323, 40325, 40330, 40331, 40503; unfigured paratypes, Nos. 40326, 40327, 40328.

**Murchisonia ? cf. M. (M.) anderdoniae,** n. sp. Pl. 32, fig. 5

*Remarks.* — Ten specimens were collected from the quarries of the France Stone Company near Silica, Ohio, and the Solvay Process Company at Sibley, Michigan, which, by themselves, appear to belong to a species distinct from *M. anderdoniae,* n. sp. However,

three or four of these specimens appear to be intermediate between typical *M. anderdoniae,* n. sp. and the most robust specimens of the form under discussion. At present there is an insufficient quantity of well enough preserved material to determine whether this is a valid species or just a more robust variation of *M. anderdoniae.*

The shell is small and high-spired, with a subangular periphery bearing a wide selenizone between two revolving lirae. The whorl profile is subangular at the periphery and lacks a shoulder. The upper whorl face has a flat to slightly concave surface between the upper suture and the selenizone. Just below the selenizone is a slight concavity about equal to or slightly greater in width than the selenizone. Below this concavity the lower whorl face has a gentle convexity to the lower suture. The sutures are deep, and the nucleus is unknown. The base is gently rounded and anomphalous. The columellar lip is arcuate and only slightly reflexed. The parietal and outer lips are unknown, though the outer lip presumably has a sinus which culminates just above the periphery in a slit or notch that gives rise to a wide, concave selenizone, bordered by two moderately strong lirae. Figured specimen, No. 40324, consists of only three later whorls, is 6 mm in height and 3.5 mm in greatest width, and has a pleural angle of 38 degrees.

This provisionally identified gastropod is highly reminiscent of *Hormotoma tricarinata* Grabau, 1910 (p. 175) (*"Homotoma tricarinata"* of pl. 25, figs. 3, 4). *H. tricarinata* occurs in the Lucas Dolomite of the Gibraltar quarry. Neither Grabau's specimens nor the Anderdon material presently available to me warrants comparison; however, they appear to belong to the same species.

*Occurrence.* — Locality A — nine specimens; locality B — one specimen.

*Figured specimen.* — No. 40324.

**Murchisonia (M.) gracilicrista** Linsley, n. sp. Pl. 33, figs. 5a-c

*Description.* — Moderately small, high-spired gastropods with a subangular periphery carrying a selenizone on a slightly raised, narrow keel; upper whorl face flat to slightly convex between upper suture and the selenizone and convex between the selenizone and the base; sutures moderately deep, with whorl faces above and below the suture intersecting at an angle of about 90 degrees; nucleus

unknown; base rounded, seemingly but not certainly minutely phaneromphalous; columellar lip thin, arcuate; parietal inductura and outer lip unknown; based on configuration of the growth lines, the outer lip probably with a moderately deep V-shaped sinus, culminating at the periphery in a short notch that generates a selenizone at the periphery of the whorl; the outer lip leaving the upper suture with marked backward obliquity and moderate forward convexity and continuing below the selenizone with a fairly strong forward obliquity and moderate forward convexity and becoming almost subradial at the umbilical shoulder; selenizone of neanic whorls concave, bounded by two strong revolving lirae which are raised above the general level of the whorl; selenizone of ephebic whorls raised above the level of the whorl on a conspicuous keel, with the two lirae forming indistinct upper and lower boundaries of the keel; lunulae indistinct; ornamentation other than mentioned above consisting of irregular, intermittently coarse growth lines. Holotype, consisting of five later whorls, 38.0 mm in height and 15.5 mm in diameter, with a pleural angle of 21 degrees.

*Remarks.* — This species somewhat resembles *Murchisonia anderdoniae,* n. sp. in the configuration of its younger whorls and differs from this species in having a more rounded whorl profile and in being at least one and one-half times as large for the same number of whorls. The adults are distinct from *M. anderdoniae* in the elevation of the selenizone, the roundness of the whorl face, and larger size of the shell. *M. gracilicrista* has about the same size as the type species of *Murchisonia, M. bilineata* (Dechen) but differs from the latter in having the selenizone raised on a keel, located at mid-whorl instead of low on the whorl. The species is known from 10 specimens, only four of which are well preserved.

The trivial name *gracilicrista* is derived from the Latin *gracilis* meaning "slender," and *crista* meaning "crest or ridge" and refers to the raised selenizone.

*Occurrence.* — Locality A — seven specimens; locality B — three specimens.

*Types.* — Holotype, No. 40500; paratype, No. 40501.

**Murchisonia (M.) sibleyensis** Linsley, n. sp. Pl. 32, figs. 7a-c

*Description.* — Small, high-spired gastropods with rounded peri-

phery, at or just below which is a selenizone between two revolving lirae; whorl profile rounded; sutures moderately shallow; base rounded, anomphalous; columellar lip arcuate, apparently slightly reflexed; parietal inductura thin; outer lip unknown, probably with a moderately deep angular sinus culminating at the periphery in a short slit that gives rise to a selenizone at mid-whorl or slightly below mid-whorl; selenizone concave between two faint revolving lirae; lunulae unknown; ornamentation, in addition to selenizone, presumably consisting of very fine growth lines. Holotype, No. 40499, consisting of eight whorls, is 6.2 mm in height and 2.5 mm in width, with a pleural angle of 21 degrees.

*Remarks.* — This species resembles the type species *Murchisonia bilineata* (Dechen) in general form and ornamentation but differs from it in being about one-third as large, in having a much narrower selenizone which is located at or slightly beneath mid-whorl. It also differs from the type species in having a completely rounded whorl face with no flattened or concave areas other than the selenizone. This species differs from *M. akidota* Linsley, n. sp. in having fewer whorls, a wider pleural angle, a narrower selenizone, and a rounded whorl face. It differs from *M. anderdoniae* Linsley, n. sp. in having a rounded whorl face and a narrower selenizone whose bordering costae are much finer. It differs from *M. desiderata* Hall of the Middle Devonian Onondaga Limestone in being much smaller and in lacking the slightly concave areas below the upper suture and below the selenizone.

This species is fairly common in the France Stone Company and Sibley quarries. The preservation of many of the specimens is relatively good; none of them, however, show the growth lines which must have been fine. All information concerning the form of the outer lip is highly speculative and based on the study of other murchisonids.

This species was given the trivial name *sibleyensis* because the best-preserved specimens are from the Sibley quarry and specimens are most abundant at that locality.

*Occurrence.* — Locality A — 17 specimens; locality B — 26 specimens; locality C — one specimen.

*Types.* — Holotype, No. 40499; figured paratype, No. 40496; unfigured paratypes, Nos. 40334, 40344.

**Murchisonia** ? sp. cf. **M. (M.) sibleyensis** Linsley, n. sp. Pl. 32, fig. 8

*Remarks.* — Many external molds of specimens were collected that are poorly preserved and lack well-defined structures essential for specific identification. The specimens are questionably assigned to the genus *Murchisonia*. Though free of an excessive layer of calcite, the molds show no trace of growth lines nor even a well-demarcated selenizone. The whorls are rounded much as in *M. sibleyensis*, n. sp. Casts made from some molds show a rounded keel at the periphery of the whorl that corresponds in position to that of the selenizone of *M. sibleyensis*. If better preserved specimens should be found with growth lines and no selenizone, it is probable that this form would then be assigned to a loxonematid group; at present it seems best to regard the molds as poorly preserved specimens of *M. sibleyenis*.

*Occurrence.* — Locality A — 30 specimens; locality B — one specimen; locality C — three specimens.

*Figured specimen.* — No. 40333.

**Murchisonia (M.) deludisubzona** Linsley, n. sp. Pl. 33, figs. 3a, b

*Description.* — Small, high-spired gastropods with rounded whorls bearing a selenizone located just below the periphery; whorl profile arched; whorl cross-section subelliptical, impressed above by preceding whorl; sutures shallow, inclined to the axis of the shell at an angle of over 80 degrees; nucleus unknown; base rounded, anomphalous; columellar lip poorly known, apparently reflexed; parietal lip with thin inductura; outer lip unknown, probably with a broad, shallow sinus culminating at the periphery in a notch or slit, which gives rise to a selenizone; based on the configuration of the growth lines the margin of the outer lip passing downward from the upper suture with moderate backward obliquity and little or no forward convexity, and presumably continuing below the selenizone with moderate forward obliquity; selenizone concave between two weak bordering lirae; lunulae unknown; ornamentation consisting of selenizone and very faint growth lines: Holotype, No. 40497, consisting of nine whorls, 8.5 mm in height and 2.8 mm in width, with a pleural angle of 21 degrees.

*Remarks.* — This species is known from three specimens from the Solvay Process Company quarry at Sibley, Michigan. This

gastropod is primarily interesting because of the light it may throw on the relationship of *Mesocoelia* Perner, 1907, to *Murchisonia* d'Archiac and Verneuil, 1841. *Mesocoelia* is distinguished from *Murchisonia* by the low position of the selenizone in *Mesocoelia,* whereas in *Murchisonia* the selenizone is located at the periphery about midway between the upper suture and the base of the whorl. On the penultimate whorl of *Murchisonia deludisubzona,* n. sp. the distance from the upper suture to the selenizone is 1 mm and that from the selenizone to the lower suture is about 0.25 mm. This low position of the selenizone suggests that this species belongs in the genus *Mesocoelia.* However, this apparent low position of the selenizone on the penultimate whorl is due to overlapping of this whorl by the succeeding ultimate whorl; on the ultimate whorl of this species the actual distances are 1 mm for the upper whorl face and 0.75 mm from the lower border of the selenizone to the base of the whorl. Thus it would seem that only consideration of the location of the selenizone on the ultimate whorl would be a valid criterion for distinguishing *Mesocoelia* from *Murchisonia* and that forms with overlapping whorls should be placed with *Murchisonia.*

*Murchisonia deludisubzona,* n. sp. can be distinguished from other species of *Murchisonia* by the apparent low position of the selenizone on the spire whorls and the rounded whorl profile. It can be distinguished from *Mesocoelia obstipisutura* Linsley, n. sp. by the shallowness of the sutures of *Murchisonia deludisubzona,* n. sp. by the mid-whorl location of the selenizone on the ultimate whorl, by its larger pleural angle, and that the sutures are more nearly perpendicular to the axis than those of *Mesocoelia obstipistura,* n. sp.

The trivial name of this species *deludisubzona* is derived from the Latin *deludo* meaning "false," *sub* meaning "under" and *zona* meaning "belt or girdle" and refers to the apparent, but not real, low position of the selenizone that characterizes this species.

*Occurrence.* — Locality B — three specimens.

*Types.* — Holotype, No. 40497; paratype, No. 40498.

### Subgenus **HORMOTOMINA** Grabau and Shimer, 1909

*Hormotomina* Grabau and Shimer, 1909, p. 651.
*Murchisonia* (in part) *in* Knight and Bridges, 1944.

*Type species.* — *Murchisonia maia,* Hall, 1861 A, p. 103.

**Murchisonia (Hormotomina) penduliobesa** Linsley, n. sp.
Pl. 33, figs. 1a-c

*Description.* — Shell moderately small, high-spired, with 11 to 12 whorls; probably with a V-shaped sinus in the outer lip, culminating just below mid-whorl in a notch that gives rise to a selenizone; neanic whorls flattened above and below the selenizone, periphery bluntly angular; early ephebic whorls rounded, somewhat pendent, profile interrupted only by the selenizone; later ephebic whorls swollen, not pendent, selenizone no longer breaking up whorl profile; sutures deep; nucleus unknown; base rounded, anomphalous; parietal, columellar, and outer lips unknown; based on the configuration of the growth lines, margin of the outer lip probably passing from the upper suture to the selenizone with a gentle backward obliquity and gentle forward convexity and below the selenizone passing onto the base with gentle forward obliquity and gentle forward convexity; base not well known; selenizone a wide band just below mid-whorl, on the periphery of the whorl; selenizone bounded by two revolving lirae, with an equally strong median lira midway between the two outer lirae; lunulae rather prominent with slight curvature; ornamentation consisting of well-defined slightly raised growth lines. Height of holotype, 13 mm; width of holotype, 5.2 mm; pleural angle 25 degrees.

*Remarks.* — This species differs from the type species *Hormotomina, H. maia* (Hall), in being one-fourth as large as the latter and in having a pendent whorl profile and more prominent growth lines that are not so oblique as those of *Hormotomina maia* (Hall). Description of outer lip is based upon the configuration of the growth lines.

In 1944, Knight and Bridge (p. 459) placed *Hormotomina* Grabau and Shimer in snonymy with *Murchisonia* d'Archiac and Verneuil. After seeing examples of *Hormotomina* [*Murchisonia (Hormotomina) penduliobesa,* n sp.] from the Anderdon Limestone, Knight suggested (personal communication to G. M. Ehlers) that *Homotomina* be recognized as a valid subgenus of *Murchisonia.* In the Treatise on Paleozoic Gastropoda (Knight, *et al.,* 1960), this suggestion was followed.

Although I feel that this interpretation is conservative, I have

followed the suggestion of considering *Hormotomina* as a subgenus of *Murchisonia*.

From the present limited knowledge of this subgenus it would seem that the subgenus *Hormotomina* is an excellent stratigraphic marker. As previously indicated, one species of the subgenus occurs in the Anderdon Limestone. *Murchisonia (Hormotomina) maia* (Hall) is from the Columbus Limestone of Ohio, which rests on strata of the Detroit River Group in northern Ohio. A third species [*M. (H.) linsleyi* Fagerstrom] has been described from the Formosa Reef Limestone of southwestern Ontario (Fagerstrom, 1961). The age of the Formosa Reef bioherms is not precisely known though they appear to be definitely of Detroit River age, presumably of pre-Anderdon time, *(op. cit.* p. 45).

*Occurrence.* — Locality B — two specimens; locality C — two specimens.

*Types.* — Holotype, No. 30678; paratype, No. 40495.

### Genus **CRENULAZONA** Linsley, n. genus

*Type species.* — Here designated as *Crenulazona angulata* Linsley, n. sp.

*Description.* — High-spired gastropods of medium size, with many angular whorls and a V-shaped sinus culminating at the periphery in a slit or notch that gives rise to a crenulated, finely nodose selenizone; upper whorl profile of ephebic whorls flat to slightly concave; lower whorl face with a broad, markedly concave area just beneath selenizone in adult whorls; base rounded, narrowly phaneromphalous; aperture poorly known; columellar lip slightly thickened in adult whorls; parietal and outer lips unknown, probably with a shallow V-shaped sinus culminating at the periphery in a slit or notch that gives rise to a selenizone; selenizone of neanic whorls bounded by two fine revolving lirae with a third lira of equal size situated in the middle of the selenizone of immature specimens; the middle lira of the selenizone becoming more prominent as mature whorls are reached until it becomes a large, convexly angular, raised area between the two, now insignificant, bordering lirae; intersection of coarse lunulae with thick central lira resulting in strong crenulated nodes on selenizone of adult whorls; ornamentation consisting only of selenizone and faint growth lines.

*Remarks.* — This genus is characterized by its many angular whorls and the unusual progressive change in the structure of the selenizone. The earliest form of the selenizone is not certainly known; possibly it is bordered by two strong lirae, resembling those of *Murchisonia anderdoniae,* n. sp. but differing from the latter in being more angular and having a more or less pendent whorl profile so that the ratio of the upper whorl face to the lower whorl face is about two to one. Nevertheless, it would seem that a murchisonid was ancestral to this genus.

The second phase of the selenizone which begins with the development of the third, intermediate lira, brings to mind the genus *Hormotomina* Grabau and Shimer although the adult whorl profile of *Hormotomina* is decidedly rounded rather than bluntly anguluar as in *Crenulazona.* It seems probable that the resemblance between these two is indicative of their close relationship; however, I hesitate to propose that the highly angular *Crenulazona* evolved from a form with as rotund a whorl face as is shown in *Hormotomina.* Nevertheless, *Murchisonia, Hormotomina,* and *Crenulazona* must be closely related, presumably with *Murchisonia* ancestral to the other two.

The genus *Crenulazona* resembles *Lodonaria* Dahmer, 1925 in its general form but differs from this genus in lacking the revolving ornamentation characteristic of the latter and apparently is especially distinct in the structure of its selenizone. Unfortunately, the holotype of *Lodonaria* is lost (Knight, 1941, p. 176); judging from a study of a paratype *(ibid.,* pl. 43, fig. 26), the selenizone is depressed between two strong revolving lirae as contrasted to the highly raised, crenulated selenizone of *Crenulazona.* It also differs from *Lodonaria* by possessing a definite though shallow sinus.

The generic name *Crenulazona* is derived from the Latin *Crenula* meaning "notch" and *zona* meaning "belt or girdle" and refers to the crenulated selenizone of this genus.

**Crenulazona angulata** Linsley, n. sp. Pl. 33, fig. 6; Pl. 34, figs. 1a-m; Pl. 35, fig. 2

*Description.* — Shell medium-sized, high-spired, with numerous angular whorls and shallow V-shaped sinus culminating at the periphery in a slit or notch of unknown depth that gives rise to a crenu-

lated, finely nodose selenizone; upper whorl face flat sloping gently downward towards selenizone at an angle of about 45 degrees with the vertical; selenizone raised above the projected surface of the whorl profile; lower whorl face with a broad, markedly concave area immediately below selenizone, then continuing roundly onto the base; base rounded, narrowly phaneromphalous; sutures sharp, moderately deep; nucleus unknown; aperture poorly known with no indication of a flaring expansion; columellar lip thin, arcuate, possibly slightly thickened on final whorl; parietal inductura unknown, probably thin; outer lip unknown, but judging from configuration of the growth lines leaving upper suture with gentle backward obliquity and slight forward convexity and continuing below the selenizone with a forward obliquity of nearly 45 degrees, thus creating a shallow sinus in the outer lip which probably culminates at the periphery in a shallow notch or slit that gives rise to a selenizone; selenizone of immature whorls (approximately the first five or six) poorly known, possibly forming a broad, flat area at the periphery bounded by two fairly strong revolving lirae; a third revolving lirae appearing in the mid-region of the selenizone of the fifth or sixth whorl and continuing on for three or four succeeding whorls; lunulae appearing on the eighth whorl, becoming progressively stronger with increase in size of whorl and causing the formation of fine nodes where they intersect the median lira; with addition of more mature whorls, flat selenizone becoming progressively more and more raised to form an angularly convex area between the two now insignificant bordering lirae; selenizone of adult whorls angular, rising to a sharp revolving keel; lunulae chevron-like forming small nodes at center of selenizone; ornamentation consisting only of selenizone and fine lies of growth; shell structure unknown; shell with septae in early whorls. Holotype, consisting of last nine whorls, 51 mm in height and 22 mm in diameter, with a pleural angle of 40 degrees.

*Remarks.* — This species is especially well represented in unit 15 ("back-reef zone") of the Brunner, Mond Canada Ltd. quarry where many adult specimens are found. The young specimens of this species are found predominantly in the biostromal beds of the Anderdon Limestone at all three localities visited by the author.

Apparently the young individuals took refuge among the stromatoporoids and corals of the biostromes and ventured out onto the back-reef, lime mud flats only when they reached maturity.

The entire development of the selenizone in this species is not shown on any single specimen, but is made evident from an examination of the whorls of a small number of well-preserved specimens.

The trivial name of this species *angulata* is derived from the Latin *angulatus* meaning "with angles" and refers to the angular adult whorl profile.

*Occurrence.* — Locality A — three specimens; locality B — six specimens; locality C — one specimen; locality D — 47 specimens.

*Types.* — Holotype, No. 30675; figured paratypes, Nos. 30674, 30676, 30677, 40489, 40490, 40491, 40492, 40493, 40494, 40507, 40554; unfigured paratypes, Nos. 40358, 40488.

### Genus **MESOCOELIA** Perner, 1907

*Mesocoelia,* Perner, 1907, p. 113.
*Hormotoma* (in part) *in* Knight and Bridges, 1944, p. 457.
*Murchisonia* (in part) *in* Knight, *et al.,* 1960, p. 1291.

*Type species.* — *Murchisonia (Mesocoelia) janus* Perner, 1907, p. 114.

**Mesocoelia obstipisutura** Linsley, n. sp. Pl. 35, figs. 1a-d

*Description.* — Small, high-spired, many whorled gastropods with an acute pleural angle; whorls rounded, bearing a selenizone between two lirae, and situated below the periphery; whorl profile rounded, sutures deep, inclined to the axis of the shell at an angle of 65 to 70 degrees; nucleus unknown; base rounded, probably anomphalous; columellar lip unknown, probably thin, arcuate; parietal lip unknown, probably with a thin inductura; outer lip unknown, apparently with a broad, moderately shallow sinus culminating below the periphery in a notch or slit that gives rise to a selenizone; the margin of the outer lip passing downward from the upper suture to the selenizone with a moderate backward obliquity; continuing below the selenizone with a slight forward convexity; selenizone very slightly concave between two weak bordering lirae; lunulae unknown; ornamentation consisting only of selenizone and faint growth lines. Holotype, No. 40341, consisting of 11 whorls, 11.3 mm in height and 1.8 mm in width, with a pleural angle of 16 degrees.

*Remarks.* — This species is fairly rare in the Anderdon Limestone and the selenizone is often not preserved or only poorly preserved so that specimens may easily be confused with *Streptacis* Meek, 1872 (p. 173) or with *Donaldina* Knight, 1933A (p. 57). Close observation has shown evidence of a selenizone on all except one specimen; it is presumed that neither of the latter genera are present and that all of the high-spired forms with rounded whorl profiles and whose suture is markedly inclined to the axis are specimens of *M. obstipisutura.*

This species is easily distinguishable from the species of *Murchisonia* by its rounded whorls, narrow pleural angle, and low position of the selenizone.

*Mesocoelia* may be distinguished from *Michelia* F. A. Roemer (1854, p. 73) by its distinct selenizone; *Michelia* has a deep sinus which does not culminate in a selenizone-generating slit.

The inclination of the sutures to the axis gives the impression that the shell had been pulled apart and stretched in an axial direction. The inclination of the sutures is the source of the trivial name *obstipisutura* from the Latin *obstipus* meaning "inclined or oblique" and *sutura* meaning "seam."

*Occurrence.* — Locality A — nine specimens; locality B — two specimens.

*Types.* — Holotype, No. 40341; figured paratypes, No. 40345, 40348; unfigured paratypes, Nos. 40343, 40344, 40346. Figured specimen referred provisionally to this species, No. 40347.

### Genus **CERITHIOIDES** Haughton, 1859

*Cerithioides* Haughton, 1859, p. 282.

*Type species.* — *Cerithioides telescopium* Haughton, 1859, p. 282, by monotypy.

**Cerithioides incomptum** Linsley, n. sp. Pl. 33, figs. 2a-f

*Description.* — Small, high-spired gastropods with a shallow sinus in the outer lip probably culminating in a slit that gives rise to a selenizone; whorl profile only slightly arched; sutures shallow; base rounded, smooth, anomphalous; parietal and columellar lips unknown; outer lip unknown but probably with a shallow sinus and a shallow slit giving rise to a selenizone at the periphery; seleni-

zone fairly low on the whorl; nucleus unknown; ornamentation consisting only of selenizone and exceedingly fine growth lines on neanic whorls; selenizone bounded by two exceedingly fine lirae, which are indistinct or absent on adult whorls of many specimens; lunulae unknown. Holotype consisting of 9 or 10 whorls, 6.25 mm in height and 2.50 mm in width, with a pleural angle of 29 degrees.

*Remarks.* — Most of the specimens of this small gastropod were found in the quarry at Sibley, Michigan; a few were collected from the Bruner, Mond Canada Ltd. quarry. The selenizone is visible on the adult whorls of well-preserved specimens; almost all specimens show the selenizone on the earlier whorls. Poorly preserved specimens, having no visible selenizone and resembling *Anematina* Knight (1933A, p. 36), have been assigned to this species. It is assumed that all similar forms from the Anderdon possessed a selenizone and that its absence is due only to poor preservation.

This species resembles the type species *Cerithioides telescopium* Haughton in general form and character of the selenizone but differs from it in being about one-tenth as large and in lacking the revolving ornamentation on the base. *C. incomptum,* n. sp. is a variable species with a pleural angle ranging from 25 to 49 degrees. This variation seems to be primarily due to age, the pleural angle generally becoming smaller as each successive whorl is added.

The trivial name of this species, *incomptum,* is from the Latin meaning "unadorned" referring to the simplicity of the shell.

*Occurrence.* — Locality B — 33 specimens; locality C — five specimens.

*Types.* — Holotype, No. 40335; figured paratypes, Nos. 40337, 40338, 40339, 40340; unfigured paratype, No. 40336.

## Order CAENOGASTROPODA Cox

### Superfamily **LOXONEMATACEA** Koken, 1889

### Family **PALAEOZYGOPLEURIDAE** Horný, 1955

### Subfamily **PALAEOZYGOPLEURINAE** Horný, 1955

### Genus **PALAEOZYGOPLEURA** Horný, 1955

*Palaeozygopleura* Horný, 1955, p. 11.

*Type species.* — *Zygopleura alinae* Perner, 1907, p. 352, by subsequent designation, Horný, 1955, p. 11.

**Palaeozygopleura sibleyense** Linsley, n. sp. Pl. 39, figs. 4a-g

*Loxonema* sp. Ehlers, Stumm and Kesling, 1951, pl. 3, fig. 24.

*Description.* — Small, high-spired gastropods consisting of about nine whorls, with a broad, shallow sinus in the outer lip; whorl profile rounded; base rounded, anomphalous; columellar lip reflexed, arcuate; parietal inductura absent; outer lip as shown by growth lines with a broad, shallow U-shaped sinus, culminating slightly below mid-whorl; no notch, slit or selenizone; ornamentation prominent, consisting of wide, raised, transverse costae sloping back from the upper suture at an angle of 15 degrees to the vertical and curving gently toward the aperture; nucleus consisting of smooth, normally dextral whorls. Holotype consists of nine whorls measuring 11 mm in height; 3.25 mm in width, with a pleural angle of 17 degrees.

*Remarks.* — This species resembles the type species *Palaeozygopleura alinae* (Perner) in general form and ornamentation but differs from the type species in that *P. sibleyense,* n. sp. has rounded costae, rather than the sharply ridged costae of the type species. The interspaces between the costae of the Anderdon form are broader than those of *P. alinae.* The sinus occurs lower on the whorl face in *P. sibleyense* and its whorls are more inflated.

*P. sibleyense* most strongly resembles *P. vesna* Horný and differs from the latter in that the costae of this new species have a slight backward slope from the upper suture rather than the forward slope found in the Czechoslovakian species. Also the costae of *P. vesna* appear to be conjoined at the top of the whorl; the costae of the Michigan form do not show this. *P. sibleyense* differs from "*Loxonema*" *(Palaeozygopleura?) hamiltoniae* Hall in being about one-half as large, in having coarser ornamentation, and a less pronounced sinus.

Paratype, No. 40347 (Pl. 39, fig. 4b) shows a constriction just below the upper suture similar to that found in some of the subspecies of *Palaeoygopleura alinae* (Perner). (Horný, 1955.)

*Occurrence.* — Locality A — five specimens; locality B — 145 specimens.

*Types.* — Holotype, No. 30686; figured paratypes, Nos. 40347, 40467, 40468, 40469, 40470, 40471; unfigured paratype, No. 40472.

**Palaeozygopleura joanni** Linsley, n. sp. Pl. 39, figs. 3a-k

*Description.* — Small, high-spired gastropods consisting of about

nine whorls, with a broad, shallow to moderately deep sinus in the outer lip; whorl profile rounded to slightly pendent, occasionally with slight revolving depression slightly below the upper suture; base rounded, anomphalous; columellar lip reflexed, arcuate; parietal inductura absent; outer lip as shown by growth lines with a broad, shallow to moderately deep U-shaped sinus, culminating at or slightly above mid-whorl; no notch, slit or selenizone; ornamentation prominent, consisting of many, closely spaced, sharp, raised, transverse costae sloping back from the upper suture at an angle of about 30 degrees to the vertical and curving back towards the aperture with a marked convexity; costae extending onto the base; nucleus consisting of smooth, normally dextral whorls. Holotype, consists of six adult whorls measuring 11 mm in height, 3.75 mm in width, with a pleural angle of 15 degrees.

*Remarks.* — This species differs greatly from the type species *Palaeozygopleura alinae* (Perner) by having finer costae that are considerably more numerous than those of the type species. Also the costae of *P. joanni,* n. sp. possess a relatively deep loxonematid sinus which is lacking in *P. alinae.*

*P. joanni,* n. sp. most closely resembles *P. parallela* Horný [*P. (Bojozyga) parallela,* Horný in Horný's 1955 paper] in that *P. parallela* has fine, closely spaced costae with a moderately deep sinus. *P. joanni,* n. sp. differs from the above mentioned species by having a wider pleural angle, by having the whorls far more inflated, by having deep sutures rather than adpressed whorls, and by having the sinus occur lower on the whorl face.

*P. joanni,* n. sp. resembles *"Loxonema" (Palaeozygopleura?) hamiltoniae* Hall strongly but differs from the latter in having finer, more numerous costae, and a moderate to strongly concave sinus. *P. joanni,* n. sp. differs from *P. sibleyense,* n. sp. by having more numerous costae which are finer and have a deeper sinus. In general the costae of *P. joanni,* n. sp. extend all of the way onto the base, whereas the costae of *P. sibleyense,* n. sp. fade out before the base is reached.

This species is named in honor of my wife, JoAnn Hoehler Linsley, in appreciation for the constant encouragement and aid in writing this paper.

*Occurrence.* — Locality A — 68 specimens; locality B — nine specimens.

*Types.* — Holotype, No. 40478; paratypes, Nos. 40473, 40474, 40475, 40476, 40477, 40479, 40480, 40481, 40482.

Subclass OPISTHOBRANCHIA Milne Edwards

Superfamily **PYRAMIDELLACEA** Phillips, 1875

Family **STREPTACIDIDAE** Knight, 1931

Genus **STREPTACIS** Meek, 1872

*Streptacis* Meek, 1872, p. 173.

*Type species.* — *Streptacis whitfieldi* Meek, 1872, p. 173, by monotypy.

**Streptacis** (?) sp. Pl. 39, fig. 2

*Remarks.* — One specimen was found in the France Stone Company quarry which has been assigned to the genus *Streptacis*. This specimen is a small, high-spired, many-whorled anomphalous gastropod with a wide, shallow sinus in the outer lip. The whorl profile is moderately arched, the sutures shallow. The nucleus is unknown. The base is rounded, anomphalous. Columellar and parietal lips are unknown. The outer lip had either an exceedingly shallow sinus or lacked a sinus. The outer lip must have been almost parallel to the axis and had only the slightest backward obliquity. On account of limited knowledge of the nature of the sinus, I question the assignment of this specimen to *Streptacis*. It could well be a paleozygopleurid, but the establishment of a more definite taxon will have to await attainment of better specimens. The ornamentation consists of fine costae-like growth lines.

The specimen is 9.5 mm in height, and 2.5 mm in width, and has a pleural angle of 15 degrees.

*Occurrence.* — Locality A — one specimen.

*Figured specimen.* — No. 40544.

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# PLATES

EXPLANATION OF PLATE 25

Figures 1-4 of latex casts

Figs. 1a-d X 1; figs. 1e-f X 2; figs. 2-5 X 4

Figure Page

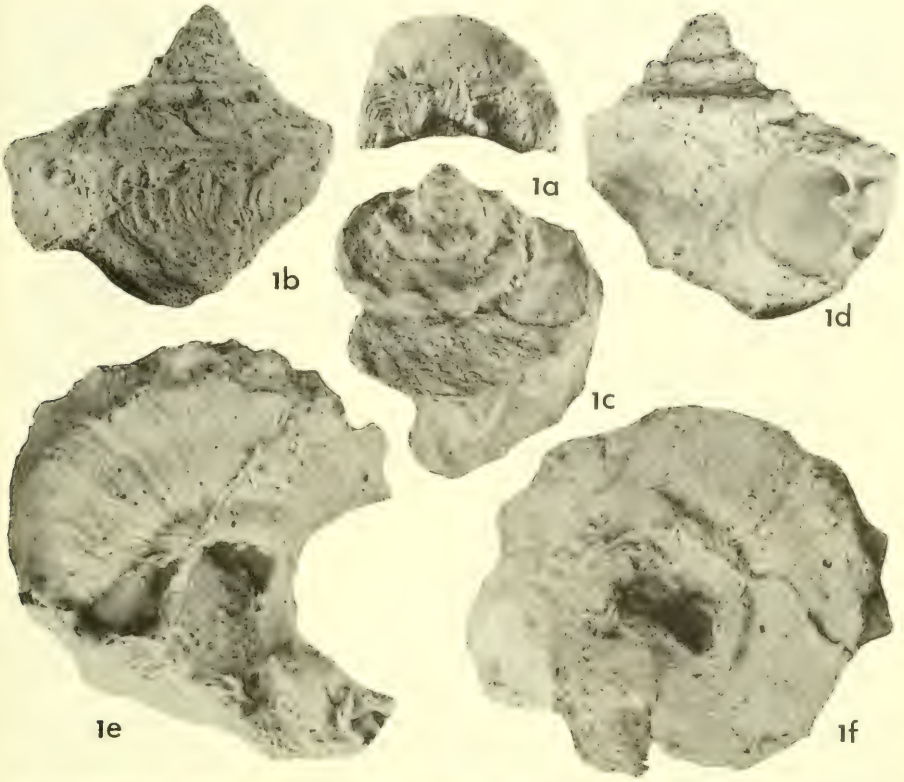
1. **Tylozone commensurata** Linsley, n. gen., n. sp. ..... 389
   a. Basal view, paratype, UMMP 40434, showing excellent preservation of circumumbilical ridge suggestive of siphonal notch. b,c,d. Adapertural, oblique apical, and apertural views of holotype, UMMP 40361, showing moderately thick parietal inductura and pronounced thickening of columellar lip which forms rough circumumbilical ridge. Apparent absence of nodes on selenizone of body whorl interpreted as a result of wear, presumably during lifetime of animal. e,f. Oblique basal view and basal view of paratype, UMMP 40436. Note umbilicus, circumumbilical ridge and groove, and moderate development of a row of nodes at juncture of base and outer whorl face.

2. **Bellerophon stummi** Linsley, n. sp. ..... 371
   a,b. Side view and dorsal view of holotype, UMMP 40512. c. Dorsal view of paratype, UMMP 40511.

3. **Tropidodiscus cultricarinatus** Linsley, n. sp. ..... 369
   a. Dorsal view of paratype, UMMP 40487. b. Side view of holotype, UMMP 40485, showing fine, sharp ornamentation.

4. **Tropidodiscus vesculilineatus** Linsley, n. sp. ..... 365
   a. Side view of holotype, UMMP 30667, showing two surface of the shell, the lower with strong, broad costae near the umbilicus, the upper acting as a cover hiding the stronger ornamentation. b. Side view of paratype, UMMP 30670 with outer shell layer complete, showing only fine growth lines. c. Dorsal view of paratype, UMMP 40483.

5. **Tropidodiscus compticarinatus** Linsley, n. sp. ..... 368
   Left side view of holotype, UMMP 30671, one of the few specimens from the Anderdon Limestone that was not preserved as a natural mold. Note the small remnant of the high dorsal keel in the lower right hand of the illustration.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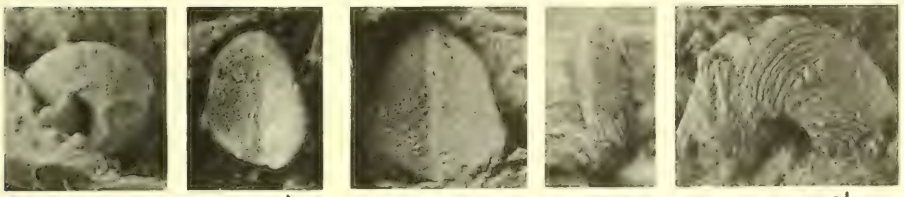
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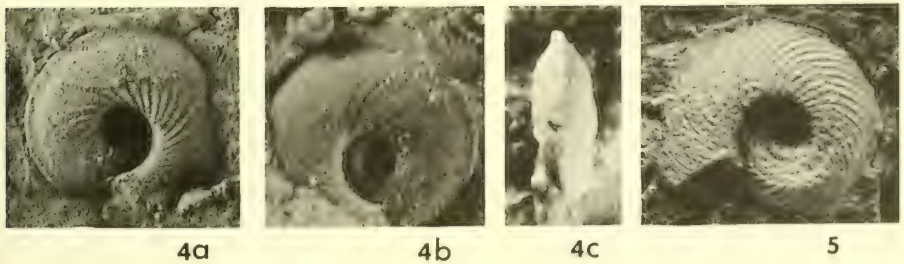
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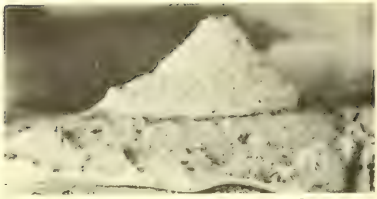
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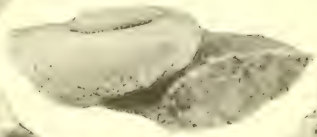
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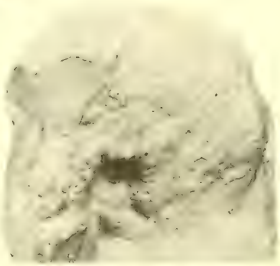
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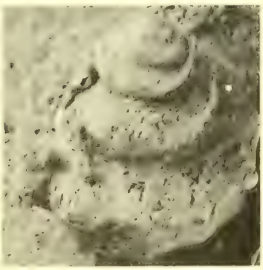
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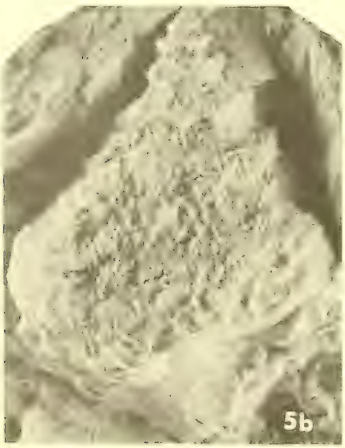
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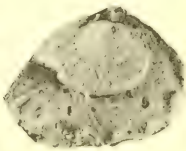
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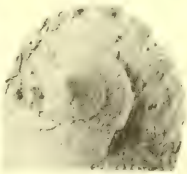
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5c

EXPLANATION OF PLATE 26

All figures of latex casts X 1 except 1c-d and 2a X 2

Figure Page

1. **Tylozone commensurata** Linsley, n. gen., n. sp. ..... 389
   a. Oblique apical view of paratype UMMP 40440, showing lunulae on selenizone of body whorl which indicate depth of slit. b. Oblique apical view of paratype, UMMP 40439, showing broken and partly obliterated selenizone of the body whorl and absence of selenizonal nodes. c,d. Apical and oblique apical views of paratype, UMMP 40438, showing progressive development of selenizone from simple, parallel-sided early phase, to gradual development of nodes with accompanying selenizonal expansion, to a later stage with large nodes on the ultimate whorl (which represents approximately the antipenultimate whorl of the holotype).

2. **Zalozone lacunata** Linsley, n. gen., n. sp. ..... 386
   a,b,c. Side, oblique apical and apical views of paratype, UMMP 40389. Note the simplicity of the selenizone on the ephebic whorls as contrasted with that of the ultimate whorl.

3. **Zalozone** cf. **Z. lacunata** Linsley, n. gen., n. sp. ..... 388
   Apertural view of steinkern of UMMP 40391.

4. **Tylozone** cf. **T. turricula** Linsley, n. gen., n. sp. ..... 393
   Oblique basal view of UMMP 40441.

5. **Tylozone turricula** Linsley, n. gen., n. sp. ..... 392
   a,c. Basal view and side view of holotype, UMMP 40443, showing high, turreted spire profile and rounded base. b. Side view of high-spired paratype, UMMP 40444.

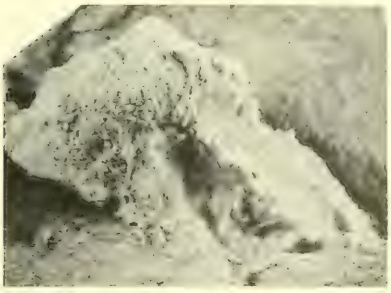
EXPLANATION OF PLATE 27

All figures of latex casts

Figure Page

1. **Zalozone lacunata** Linsley, n. gen., n. sp. ..... 386
a,b. Oblique basal and apertural views (X2) of paratype, UMMP 40390. Note the circumumbilical groove. c,d,e. Reconstruction of *Z. lacunata* (by John R. Chapin). f,g. Side (X2) and apical (X1) of holotype, UMMP 40388. h. Side view (X4) of paratype, UMMP 40392, showing two heavy bands bordering selenizone.

2. **Zalozone** cf. **Z. lacunata** Linsley, n. gen., n. sp. ..... 388
Side view (X2) of UMMP 40391. Note difference in whorl profile from holotype.



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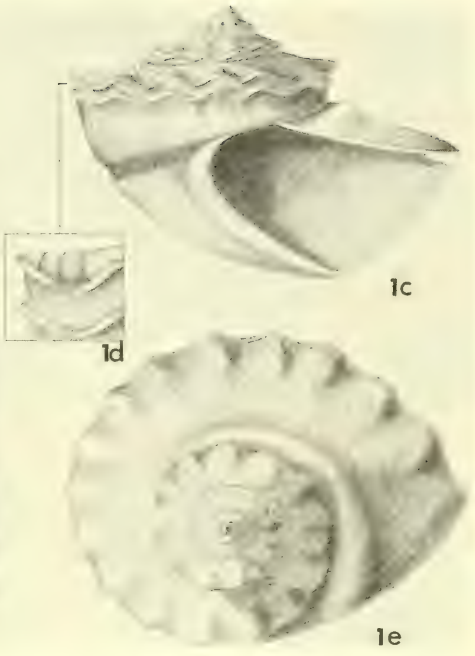

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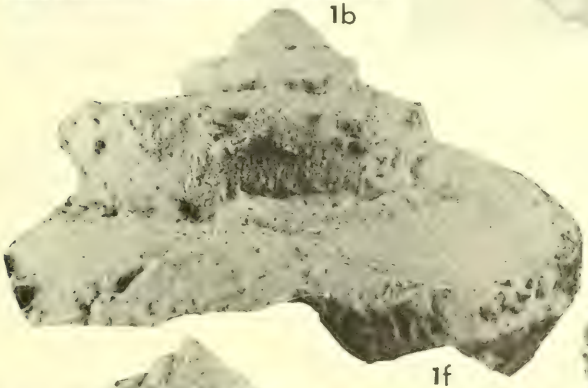

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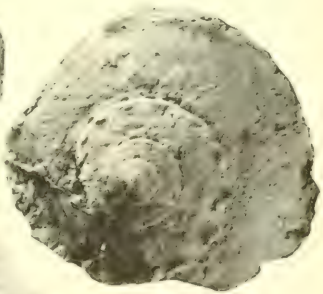

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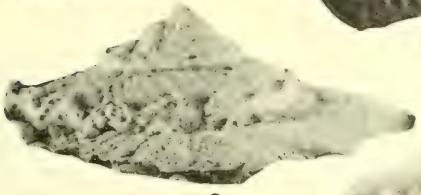

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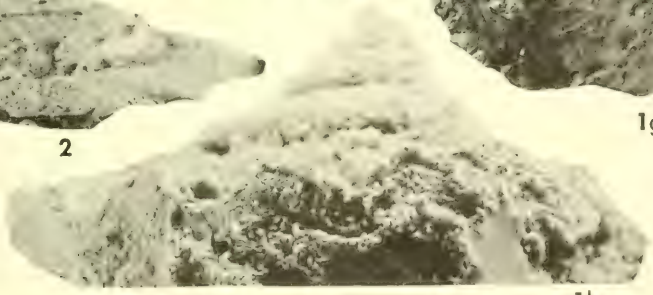

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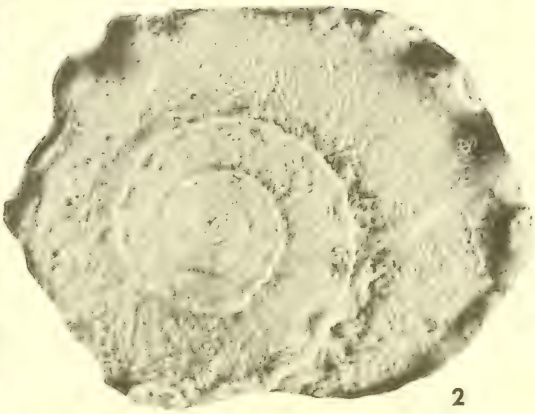
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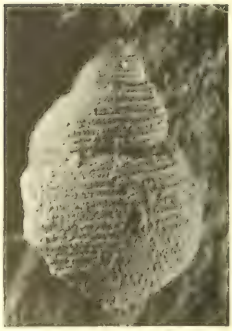
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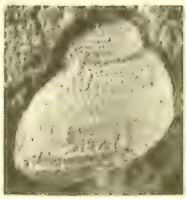
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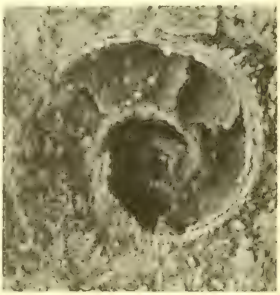
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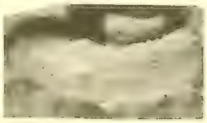
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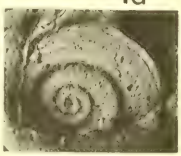
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EXPLANATION OF PLATE 28

All figures of latex casts X 4 except 1g and 2 (X 2) and 3m (X 8)

Figure Page

1. **Euryzone petilitornata Linsley,** n. sp. ..... 398
   a,b,c. Side, apical, and oblique apical views of immature paratype, UMMP 40321. The nucleus is smooth. The selenizone is tilted at a smaller angle to the axis of the shell than is the case in adult whorls. d. Apical view of paratype, UMMP 30672, with pleural angle of 180° and no tendency towards uncoiling. e. Side view of paratype, UMMP 40464, showing considerable outward deflection of the ultimate whorl with only slight downward depression. f. Apical view of paratype, UMMP 40458 with slightly depressed ultimate whorl. g. Basal view of shell interior of paratype, UMMP 40463, showing two-layered shell and unevenly spaced septa.

2. **Zalozone** cf. **Z. lacunata** Linsley, n. gen., n. sp. ..... 388
   Apical view of UMMP 40391.

3. **Nodonema granulatum** Linsley, n. gen., n. sp. ..... 395
   a. Side view of paratype, UMMP 40379, largest specimen in the collection. b. Side view of paratype, UMMP 40373. c. Side view of holotype, UMMP 40369. Selenizone occupies two inter-liral bands immediately below the heavy lira at juncture of outer whorl face and base. d. Side view of paratype, UMMP 40375, showing round whorl profile and coarse nodes. e. Apertural view of paratype, UMMP 40376, showing subcircular whorl profile (contrasted to the pendant profile of horizontally oriented specimen). f. Side view of paratype, UMMP 40370, with flattened whorl face. g. Basal view of paratype, UMMP 40375, showing selenizone. h. Side view of paratype, UMMP 40372, showing fine nodular ornamentation on penultimate whorl, but with body whorl almost devoid of nodes. i. Oblique basal view of paratype, UMMP 40380, showing lunulae and central lira of the selenizone. j. Side view of paratype, UMMP 40371, an immature specimen with well-developed nodes on the revolving lirae. k. Side view of paratype, UMMP 40377, showing revolving lirae without nodes. m. Side view of paratype, UMMP 40374, a young specimen showing the unadorned, normally dextral nucleus and the ephebic whorl with nodose threads.

EXPLANATION OF PLATE 29

All figures of latex casts

Figs. 1a,b,c,2a,b,c,3a,e, X 2; figs. 3b,c,d,f,g,h,4a,b, X 4

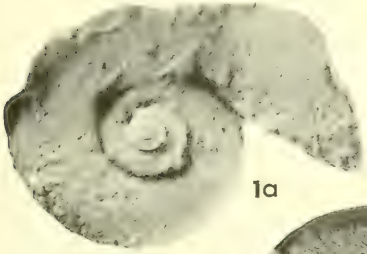
Figure — Page

1. **Euryzone pharkidopyndax** Linsley, n. sp. ..... 400
   a,b,c. Apical, basal, and side views of holotype, UMMP 40509.

2. **Euryzone latitornata** Linsley, n. sp. ..... 399
   a,b,c. Side, apical, and basal views of holotype, UMMP 40466, showing width and depth of whorls, rounded upper whorl face, smooth base and inclination of selenizone.

3. **Euryzone petilitornata** Linsley, n. sp. ..... 398
   a. Oblique apical view of paratype, UMMP 40382, showing ultimate whorl slightly disengaged and raised above the normal plane of coiling. b. Oblique apical view of paratype, UMMP 40459, showing ultimate whorl greatly depressed but not deflected outward. c,e. Apical and basal views of paratype, UMMP 40356, the largest specimen in the collection. Its pleural angle approaches 180°, and the shell shows no tendency toward uncoiling. d,f. Side and apical views of holotype, UMMP 40462, showing inclination of the selenizone, lunulae, and uncoiling of last two whorls with the final whorl being slightly raised above the plane of the spire. g. Apical view of paratype, UMMP 30673, showing marked uncoiling of ultimate whorl. h. Oblique apical view of paratype, UMMP 30689, showing uncoiling and depression of body whorl.

4. **Coelozone fasciata** Linsley, n. sp. ..... 397
   a,b. Side view and apical view of holotype, UMMP 40386.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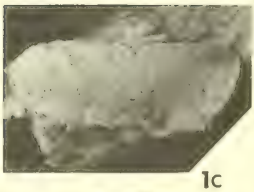
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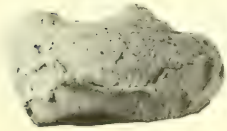
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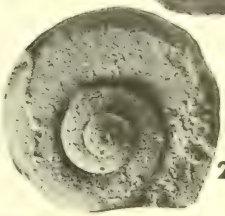
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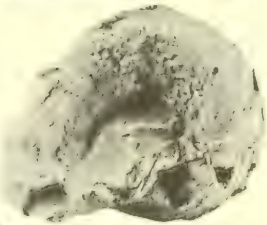
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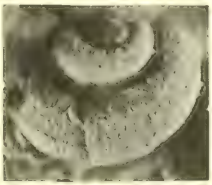
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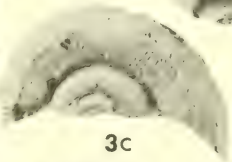
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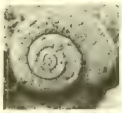
4b

3d

3g

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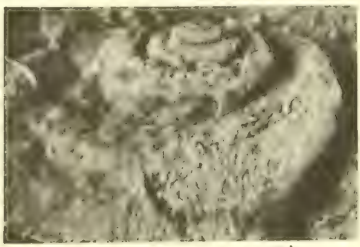
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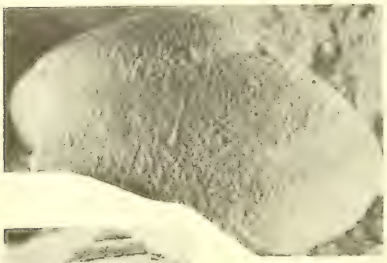

1a

2a

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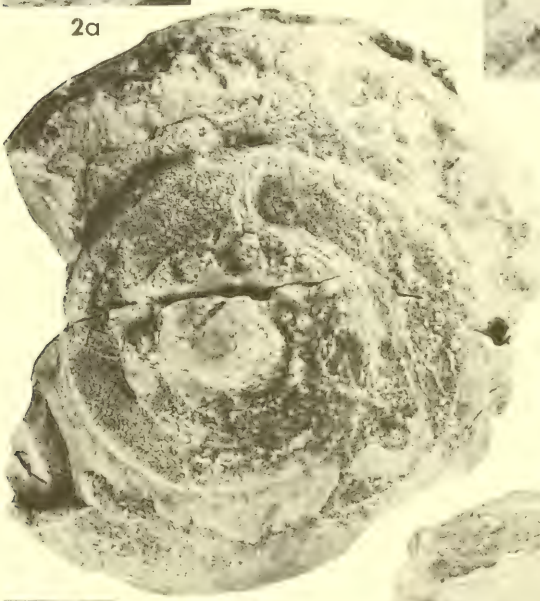

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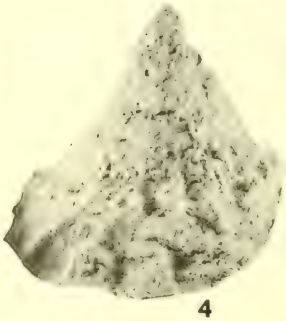


4

2b

2c

3b

EXPLANATION OF PLATE 30

Figure Page

1. **Cataschisma** sp. ..... 404
   a,b. Side view and apical view (X2) of latex cast of specimen, UMMP 40506, showing broad, shallow, ill-defined selenizone just above periphery of the whorl.

2. **Euryzone latitornata,** n. sp. ..... 399
   a,b. Side view and apical view (X4) of latex cast of paratype, UMMP 30687. c. Oblique apical view (X4) of latex cast of paratype, UMMP 40461. This is a cast of the outer face of the inner shell layer showing incised lirae bordering selenizone.

3. **Euryzone** ? sp. A ..... 402
   a,b. Apical view and basal view (X1) of natural sandstone cast of UMMP 40406.

4. **Ehlersina** ? sp. ..... 383
   Oblique apical view (X1) of UMMP 40428, showing concave spire profile and thick ribs that extend completely across the outer whorl face.

EXPLANATION OF PLATE 31

Figs. 2a,b,d,e,3,4, of latex casts; figs. 1a,b,c,d,2a,4, X 1; figs. 2b,c,d,e, X 2; fig. 3, X 4

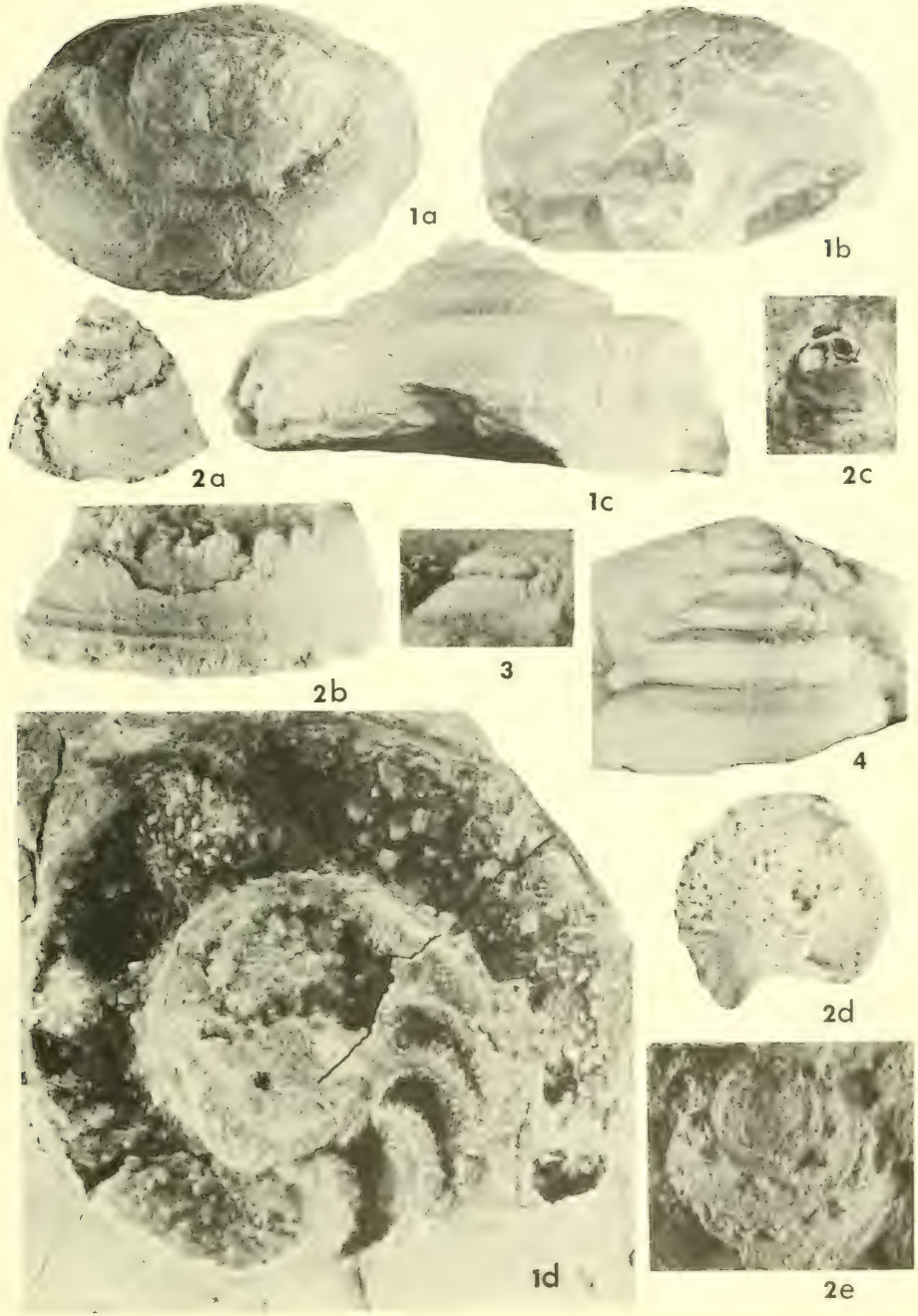
Figure Page

1. **Euryzone** ? sp. A ..... 402
   a,b. Oblique apical and oblique basal views of UMMP 40409, showing a moderately deep sinus at the upper boundary of the outer whorl face and a shallower sinus at the lower boundary of the outer whorl face. c. Side view of UMMP 40407. d. Apical view of the interior of UMMP 40413, showing thickness of shell and irregularly distributed septae.

2. **Ehlersina abditinoda** Linsley, n. gen., n. sp. ..... 380
   a. Oblique apical view of paratype UMMP 40418. b. Side view of paratype, UMMP 40423, showing narrow selenizone with faint lunulae. c. Oblique basal view of paratype, UMMP 40426, showing septa in apical region of shell. d. Basal view of immature specimen, paratype, UMMP 40419, showing small umbilicus. e. Oblique apical view of paratype, UMMP 40421, showing upper row of nodes wrapped about the basal nodes of the previous whorl.

3. **Mourlonia** ? sp. ..... 378
   Side view of UMMP 40513.

4. **Euryzone** ? sp. B. ..... 403
   Side view of UMMP 40408.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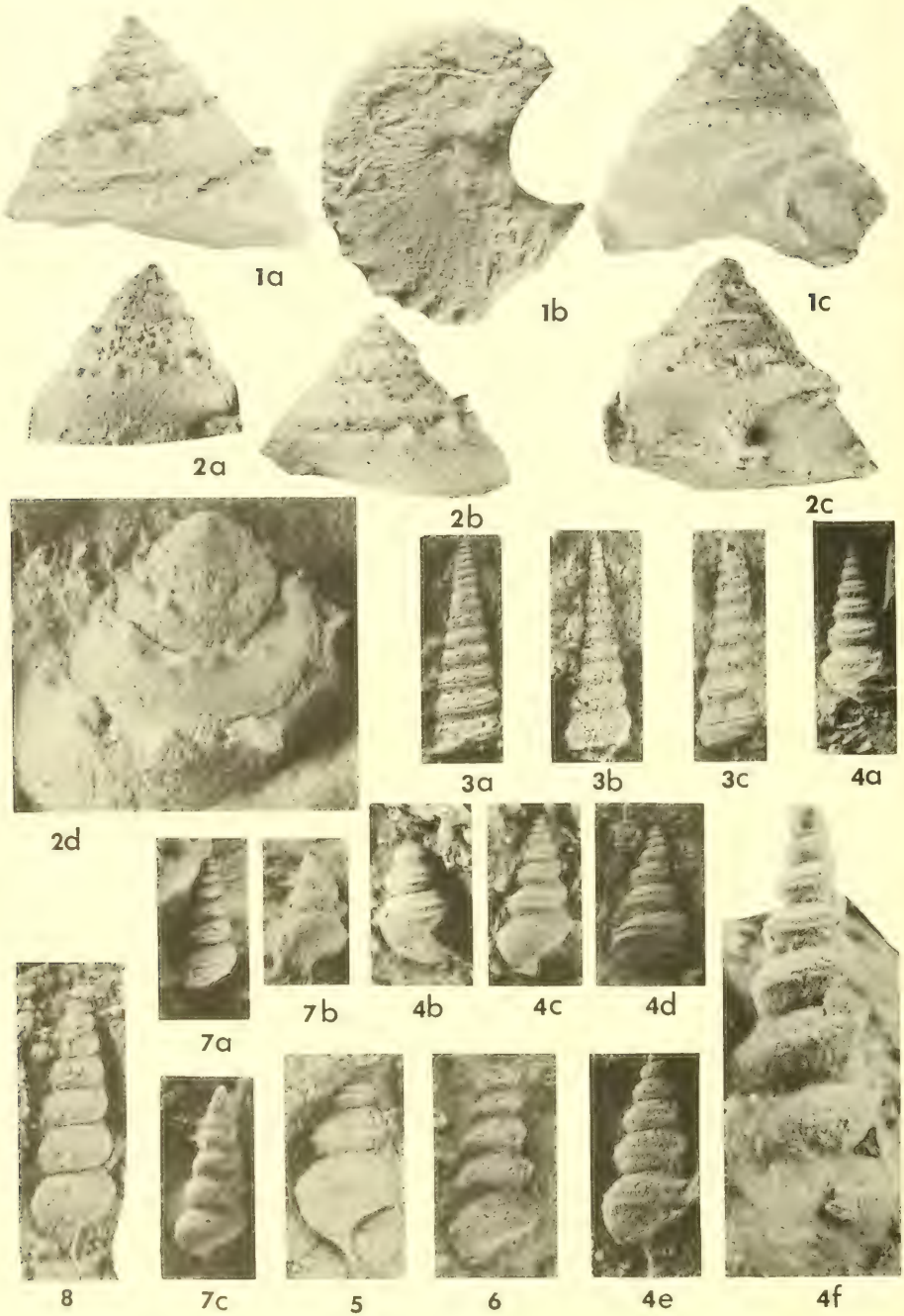
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4f

EXPLANATION OF PLATE 32

All figures of latex casts

Figs. 1a,b,c,2a,b,c, X 1; fig. 2d X 2; all other figures X 4

Figure Page

1. **Ehlersina abditinoda** Linsley, n. gen., n. sp. ..... 380
   a,c. Side view and oblique basal view of holotype, UMMP 40417. b. Basal view of paratype, UMMP 40429, showing slight extension of nodes onto base and callus covering umbilicus.

2. **Ehlersina paucinodosa** Linsley, n. gen., n. sp. ..... 382
   a. Side view of holotype, UMMP 40424, showing the arched outer whorl face and relative sparseness of nodes. b. Side view of paratype, UMMP 40427. c. Oblique basal view of paratype, UMMP 40425. d. Oblique apical view of paratype, UMMP 40422. Note narrow selenizone immediately above adpressed nodes.

3. **Murchisonia (Murchisonia) akidota** Linsley, n. sp. ..... 420
   a. Side view of holotype, UMMP 40322. b,c. Opposing side views of paratype, UMMP 40319.

4. **Murchisonia (Murchisonia) anderdoniae** Linsley, n. sp. 421
   a. Side view of paratype, UMMP 40331, a slender specimen. b. Side view of paratype, UMMP 40330. c. Side view of holotype, UMMP 40329. d. Side view of paratype, UMMP 40325, showing deep sutures of this specimen. e. Apertural view of paratype, UMMP 40323, showing deep base and slight concavity immediately beneath selenizone. f. Side view of largest paratype, UMMP 40503.

5. **Murchisonia** cf. **M. (M.) anderdoniae,** Linsley, n. sp. ..... 423
   Apertural view of UMMP 40324, showing large pleural angle and broad concave area below selenizone.

6. **"Solenospira ? extenuatum"** (Hall), Grabau ..... 422
   Side view of Grabau's holotype, UMMP 12175B. This specimen may be conspecific with *Murchisonia (M.) anderdoniae,* n. sp. but it is too imperfectly preserved for generic or specific identification.

7. **Murchisonia (Murchisonia) sibleyensis,** Linsley, n. sp. 426
   a. Side view of holotype, UMMP 40449, showing round whorl profile and narrowness of selenizone. b,c. Oblique basal and side views of paratype, UMMP 40496, showing smooth, rounded base.

8. **Murchisonia** cf. **M. (M.) sibleyensis,** Linsley, n. sp. ..... 425
   Side view of UMMP 40333.

EXPLANATION OF PLATE 33

All figures of latex casts

Fig. 6 X 2; all other figures X 4

Figure — Page

1. **Murchisonia (Hormotomina) penduliobesa** Linsley, n. sp. — 429
   a,b. Opposing side views of holotype, UMMP 30678, showing lunulae with intermediate lira bisecting them. c. Side view of paratype, UMMP 40495, a badly worn, but mature and robust specimen.

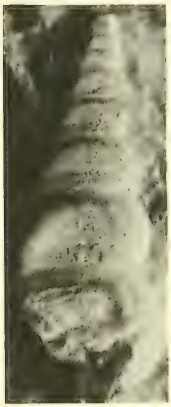
2. **Cerithioides incomptum** Linsley, n. sp. — 434
   a,f. Side and oblique apical views of paratype, UMMP 40340. b. Side view of paratype, UMMP 40339. c. Side view of paratype, UMMP 40337. d. Side view of paratype, UMMP 40338, showing faint selenizone on body whorl. e. Side view of holotype, UMMP 40335. Selenizone is barely visible on all whorls.

3. **Murchisonia (Murchisonia) deludisubzona** Linsley, n. sp. — 427
   a. Side view of holotype, UMMP 40497. Note the rounded, relatively broad whorls. b. Side view of paratype, UMMP 40498.

4. **Loxoplocus (Donaldiella)** ? — 384
   Side view of UMMP 40342.

5. **Murchisonia (Murchisonia) gracilicrista** Linsley, n. sp. — 424
   a. Side view of paratype, UMMP 40501. b,c. Side view and oblique basal views of holotype, UMMP 40500, showing pronounced keel on which the selenizone is located in the adult whorls.

6. **Crenulazona angulata** Linsley, n. gen., n. sp. — 432
   Side view of holotype, UMMP 30675.



1a

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1c

2a

2b

2c

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2f

3a

3b

4

5a

5b

5c

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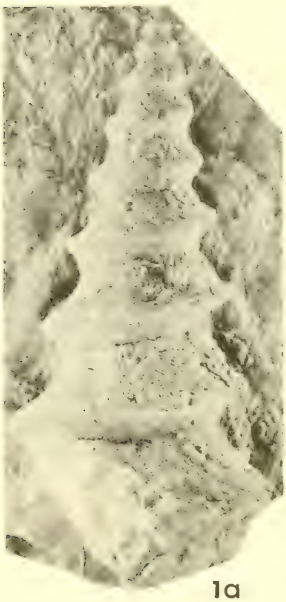
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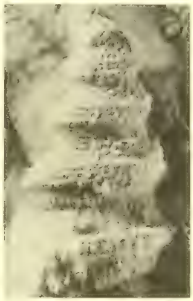
1f

1g

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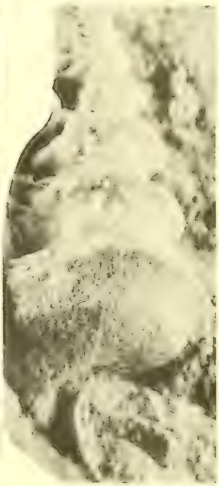
1i

1j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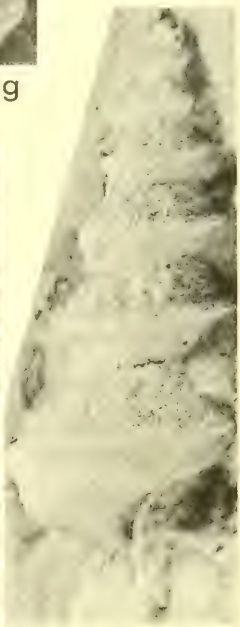
1m

EXPLANATION OF PLATE 34

All figures of latex casts

Figs. 1a,b,i,k,m, X 2; figs. 1c,d,e,f,g,h,j, X 4

Figure Page

1. **Crenulazona angulata** Linsley, n. gen., n. sp. ..... ..... 432

a. Side view of paratype, UMMP 30676. b. Side view of paratype, UMMP 30674, well-preserved specimen showing the character of the selenizone in early ephebic whorls. Note that the central lira has broken nodes. c. Side view of paratype, UMMP 40507, showing the central lira of the selenizone of neanic whorls. d. Side view of paratype, UMMP 40493, showing structure of the selenizone of a middle or late ephebic whorl. Note how the central selenizonal lira has become a raised, angular central area, with long crenulations derived from thickened lunulae. e. Side view of paratype, UMMP 40491, provisionally assigned to this species as representative of the earliest whorls of this species. f. Side view of paratype, UMMP 40492, showing progressive development of the selenizone from three-banded late neanic stage to early ephebic stage with crenulated central lira. g. Side view of paratype, UMMP 40554, showing change in selenizone from neanic to ephebic whorls. h. Side view of paratype, UMMP 40494, showing three-banded neanic selenizone. i. Side view of paratype, UMMP 30677. j. Side view of paratype, UMMP 40490, showing development of the selenizone from three-banded neanic stage to a relatively mature ephebic stage having a well-crenulated selenizone. k,m. Oblique basal view and side view of paratype, UMMP 40489, showing narrow umbilicus and reflected inner lip.

EXPLANATION OF PLATE 35

All figures of latex casts

Fig. 2X 2; all other figures X 4

Figure — Page

1. **Mesocoelia obstipisutura** Linsley, n. sp. ..... 433
   a. Side view of holotype, UMMP 40341, showing typical low position of the selenizone and inclination of the sutures. b. Side view of paratype, UMMP 40347. This specimen has the selenizone in the low position but lacks the inclination of the sutures. c. Side view of paratype, UMMP 40348. d. Side view of paratype, UMMP 40345.

2. **Crenulazona angulata,** Linsley, n. gen., n. sp. ..... 432
   Basal view of holotype, UMMP 30675, showing umbilicus and thickened columellar lip.

3. **Straparollus (Serpulospira) diversiformis** Linsley, n. sp. morphotype "A" ..... 373
   a,b. Apical view and basal view of paratype, UMMP 30682, showing uncoiling already present in this immature specimen. c,d. Apical view and oblique apical view of paratype, UMMP 40445, showing conspicuous uncoiling in one plane. e. Basal view of paratype, UMMP 40446.

4. **Straparollus (Serpulospira) diversiformis** Linsley, n. sp. morphotype "B" ..... 373
   a,b. Apical view and basal view of holotype, UMMP 30680, showing little uncoiling. Note the strong resemblance to *S. (Straparollus)* in regards to the lack of uncoiling. c. Basal view of paratype, UMMP 40448. d. Apical view of paratype, UMMP 40449, showing well-defined growth lines.

5. **Straparollus (Serpulospira) diversiformis** Linsley, n. sp. morphotype "C" ..... 373
   a,b. Oblique apical view and apical view of paratype, UMMP 40452. c,d,e. Apical view, oblique apical view, and basal view of paratype, UMMP 30684, showing whorls that are strongly depressed but not deflected outward.

6. **Straparollus (Serpulospira) diversiformis** Linsley, n. sp. morphotype "D" ..... 373
   a. Basal view of paratype, UMMP 40453. b,c. Apical view and oblique apical view of paratype, UMMP 40454, showing whorls that are greatly deflected and depressed. d. Apical view of paratype, UMMP 30681.

1a

1b

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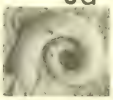
3a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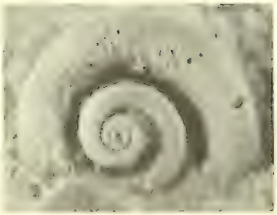
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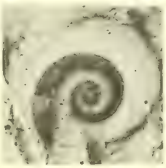
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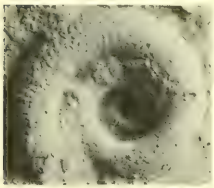
4a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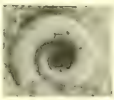
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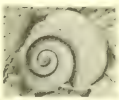
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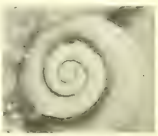
5a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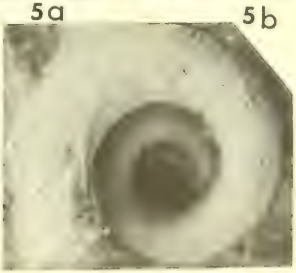
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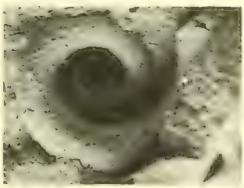
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6b

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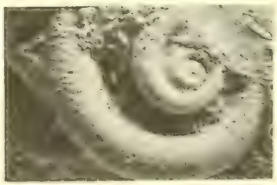
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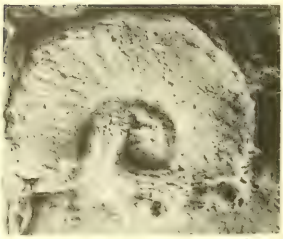
1a

4a

4b


1b

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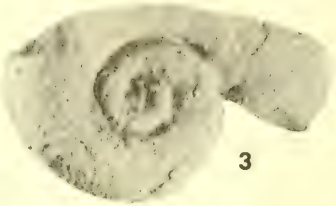
4c

4d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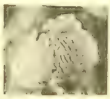
6a

6b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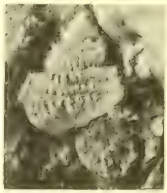
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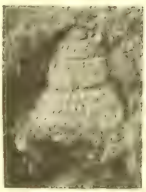
6h

6i

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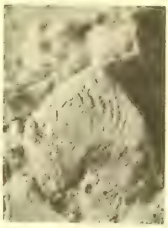
6m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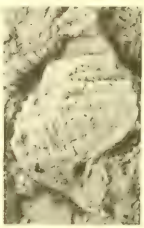

6p

6q

6r

EXPLANATION OF PLATE 36

All figures of latex casts

Figs. 1a,b,2,3, X 1; figs. 4a,b,c,d,6b, X 8; all other figures X 4

Figure — Page

1. **Straparollus ? (Euomphalus)** sp. C. ..... 377
   a,b. Apical view and basal view of UMMP 40416.

2. **Straparollus ? (Euomphalus)** sp. A. ..... 376
   Apical view of UMMP 40414.

3. **Straparollus ? (Euomphalus)** sp. B. ..... 376
   Apical view of UMMP 40415.

4. **?Isonema ? corrugata** (Stauffer) ..... 412
   a,b. Apical view and side view of UMMP 40405. c,d. Side view and apical view of UMMP 40508.

5. **Isonema ? corrugata** (Stauffer) ..... 411
   a,b. Side view and apical view of UMMP 40518.

6. **Microdoma tricarinata** (Grabau) ..... 409
   a. Oblique basal view of hypotype, UMMP 40484, a specimen whose lower row of nodes is slightly developed. Note the narrow umbilicus and the thickened columellar and lower outer lip. b,c. Side views of immature hypotype, UMMP 40400. d. Side view of hypotype, UMMP 40401. e,k. Apertural view and oblique basal view of hypotype, UMMP 40402, showing subcircular whorl profile, small umbilicus, and wide shoulder formed by uppermost row of nodes. f. Side view of hypotype UMMP 40399, a small specimen showing a relatively large, smooth nucleus. g. Side view of hypotype, UMMP 40403. This immature specimen demonstrates well the transition from a smooth nucleus to the varix-like costae of the neanic whorls and the disintegration of these costae into rows of nodes. Note the elongated lower row of nodes. h. Side view of Grabau's holotype, UMMP 12175A, a specimen lacking the base. i. Side view of hypotype, UMMP 40404, a specimen lacking the lowest row of nodes. j. Side view of hypotype, UMMP 40395. m,n. Side view and oblique basal view of hypotype, UMMP 40394, a specimen with the lower row of nodes greatly elongated and extended onto base. p. Side view of hypotype, UMMP 40396. q. Oblique apical view of hypotype, UMMP 40393, showing heavy growth lines near aperture. r. Side view of hypotype, UMMP 40502, a relatively large specimen with deep sutures. The lowest row of nodes is missing on all whorls.

EXPLANATION OF PLATE 37

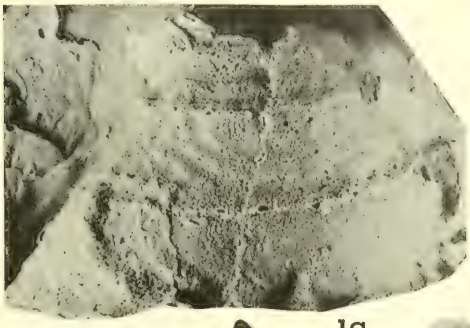
All figures except 2a,b of latex casts

Figs. 1a,b,d,e,f,g, X 1; figs. 1c,2a,b, X 2

Figure Page

1. **Scalaetrochus fragosus** Linsley, n. sp. ..... 413
   a. Side view of paratype, UMMP 40432, showing thick, irregularly spaced growth lines. b. Side view of paratype, UMMP 40353. c. Oblique basal view of paratype, UMMP 40363, a poorly preserved specimen which nevertheless shows the characteristics of the flat base. d. Side view of paratype, UMMP 40431, showing well-preserved growth lines on the ultimate whorl. e. Side view of holotype, UMMP 40430, showing concave spire profile and overhanging base. f,g. Opposing side views of paratype, UMMP 40433, showing overhanging frill and flat base.

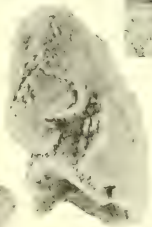
2. **Platyceras (Platyceras)** sp. ..... 405
   a,b. Front view and side view of UMMP 40504.



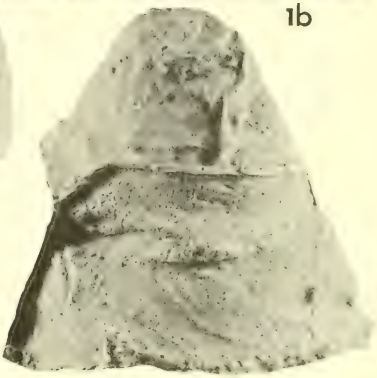
1a

1b

1c



2a



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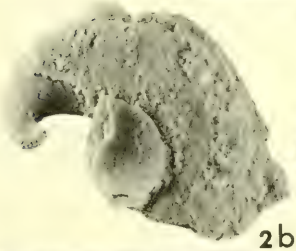
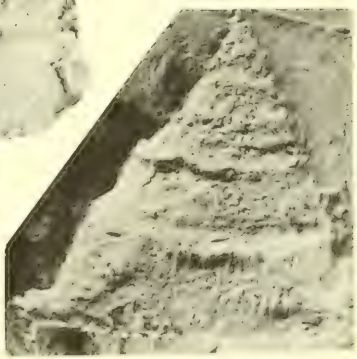


2b

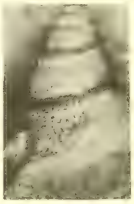
1e

1f



1g

1a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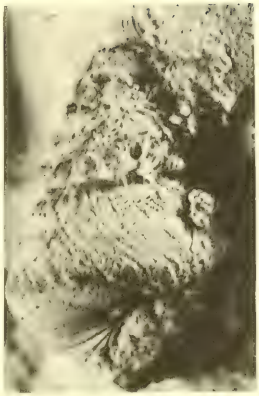
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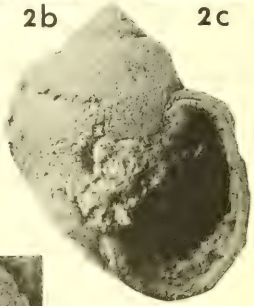
2b

2c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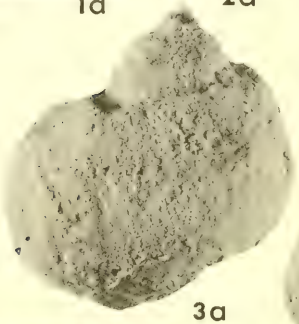
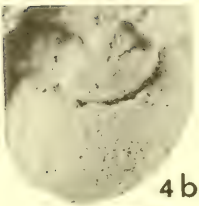

3a

4a

2d

6a

6b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5b

5c

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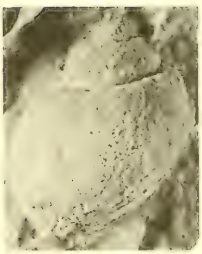
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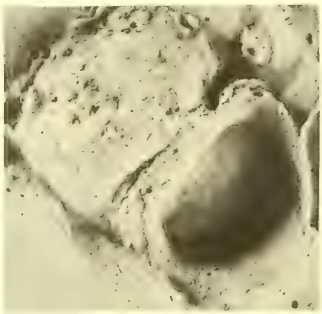

3b

3c

EXPLANATION OF PLATE 38

All figures of latex casts except figure 3c

Figs. 3a,b,c,4a,b,c,5a,c, X 2; figs. 1a,2a,b,c,d,5b,6a,b,c, X 4; fig. 1b, X 8

Figure — Page

1. **Pagodea falcatinoda** Linsley, n. sp. ..... 406
   a,b. Oblique basal view and side view of holotype, UMMP 40384, showing thin apertural lip, absence of an umbilicus, and sickle-shaped nodes at the periphery. The lighting on fig. 1b emphasizes the growth lines, but fails to show the prominence of the middle, revolving lira. Note carinate ornamentation of the neanic whorl.

2. **Copidocatomus collarus** Linsley, n. gen., n. sp. ..... 408
   a,c,d. Opposing side views and oblique basal view of holotype, UMMP 40381. The primary light of fig. 2a was placed at the lower right to emphasize whorl profile and sharp revolving carinae bordering the outer whorl face. The primary light of fig. 2c was placed at the lower left to emphasize growth lines. b. Side view of paratype, UMMP 40383, showing sharp angulations bordering flattened outer whorl face.

3. **Naticopsis (Naticopsis) opimavoluta** Linsley, n. sp. 416
   a,b. Side view and apertural view of holotype, UMMP 40354. c. Cross-section of paratype, UMMP 40365. Note how the two shell layers thicken at the apertural shoulder and are separated from each other (by solution?).

4. **Naticopsis (Naticopsis) planifrons** Linsley, n. sp. ..... 417
   a,c. Oblique apical view and side view of holotype, UMMP 40359, showing sharp, deeply incised sutures, and the absence of a pronounced shoulder. b,d. Oblique apical view and side view of paratype, UMMP 40355.

5. **Naticopsis (Naticopsis) pegmihumerosa** Linsley, n. sp. 414
   a. Apertural view of holotype, UMMP 40350, showing wide shoulders, deep body whorl, and thickened aperture. b. Oblique apical view of paratype, UMMP 40360. c. Apertural view of paratype, UMMP 40352.

6. **Turbonitella trunculinoda** Linsley, n. sp. ..... 418
   a,b. Side views of holotype, UMMP 40367. c. Side view of paratype, UMMP 40368.

EXPLANATION OF PLATE 39

All figures of latex casts

Figs. 1a,b, X 2; figs. 4a,e,g, X 8; all other figures X 4

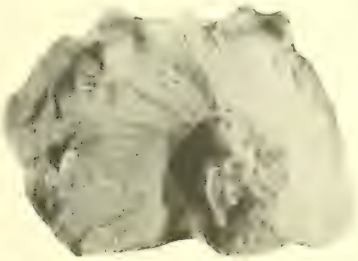
Figure — Page

1. **Omphalocirrus** sp. ..... 372
   a,b. Basal view and slightly oblique basal view of UMMP 40385, showing the spines around the periphery and the bundling of the growth lines.

2. **Streptacis** ? sp. ..... 438
   Side view of UMMP 40544. Note fine costae and inclination of sutures.

3. **Palaeozygopleura joanni,** Linsley, n. sp. ..... 436
   a. Side view of paratype, UMMP 40480, showing extreme backward obliquity of the costae of the ultimate whorl of this rotund individual. b. Side view of paratype, UMMP 40475. The ultimate whorl has been broken back for about one-half of a volution. c. Side view of paratype, UMMP 40476, showing smoothness of the nucleus and the erectness of the earliest costae. d. Side view of paratype, UMMP 40473. e. Side view of paratype, UMMP 40481. Note the much finer costae on the ultimate whorl. f. Side view of paratype, UMMP 40479. g. Apertural view of holotype, UMMP 40478. h. Side view of paratype, UMMP 40482. i. Side view of paratype, UMMP 40477. j,k. Apertural view and side view of paratype, UMMP 40474, showing an extreme condition of crowding of costae.

4. **Palaeozygopleura sibleyense** Linsley, n. sp. ..... 436
   a. Apertural view of paratype, UMMP 40471, showing wide pleural angle of this immature specimen. b. Side view of paratype, UMMP 40347, showing wide spacing of costae and slight constriction just below suture. c. Side view of paratype, UMMP 40470. d. Side view of holotype, UMMP 30686.



1a

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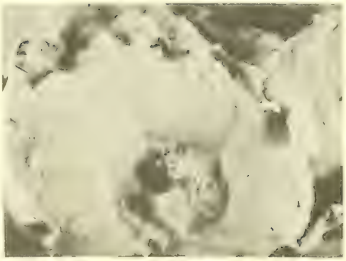

1b

3a

3b

3c

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